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BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXIII.

1891.

SALEM, MASS.:
PRINTED BY THE SALEM PRESS PUBLISHING AND PRINTING CO.,
1891.

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 23. SALEM: JAN., FEB., MAR., 1891. NOS. 1, 2, 3.

AN AID TO A COLLECTOR OF THE CŒLENTERATA AND ECHINODERMATA OF NEW ENGLAND.

BY J. WALTER FEWKES.

I. INTRODUCTION.

It is very difficult for one wishing to study the development or anatomy of any marine animal to know when and where to find the eggs, young and adult. It is also not easy to recognize the young of certain members of our marine fauna, when they are found. It is also difficult to identify the adult.

The following pages are intended to serve as a help in the identification of the adults and young of the more common Cœlenterata and Echinodermata of the waters of New England. They are written for those[1] who wish some means by which to learn the names and the general external characters of the common forms of life, which have their homes on our coasts. The author follows with admiration the plan adopted by Philip Gosse in a too little known Manual of Marine Zoology, which without claim for originality he has simply modified to meet the necessities of the present case. The lament which Gosse makes that the information necessary to identify the common animals of Great Britain is scattered through monographs, many of

[1]This key to the identification of New England Cœlenterata and Echinodermata was prepared for the members of the Teachers' School of Science who attended my course of lectures in the winter of 1890. It is intended to be used as an introduction to a study of their notes on some of those lectures.

which are in a foreign tongue, may with still greater emphasis be repeated by us in New England, especially as far as the young of our marine animals are concerned. These chapters are written as introductions to larger works and more exhaustive monographs.

These pages may be of use to those who, while not beginners, have yet made such progress in the study of our marine animals as to wish some guide in the determination of a few of the different specific forms of lower marine life which he meets. It is not a monograph nor an original contribution to the subject. It is an aid to the collector, and is intended to meet certain difficulties which even the professional naturalist encounters in the identification of animals.

II. KINDS OF COLLECTING.

It is well for the student of our Cœlenterata and Echinodermata to be familiar with methods of collecting in three different regions.

A. Shore Collecting, or collecting of animals from the littoral zone.

B. Dredging, or collecting from depths below low tides.

C. Surface Collecting, or collecting from the surface of the water.

A. Shore Collecting.

In order to study the marine larvæ of jellyfishes and starfishes, it is often necessary to raise them from the egg. The capture of adults with ova is therefore a desideratum. The apparatus employed in shore collecting is very simple. A jar or pail for specimens, a shovel or trowel and a hand net are all that is required. The time for collecting is generally at low-tide, and as more animals are washed up after rough weather, the last days of a storm give the best results.

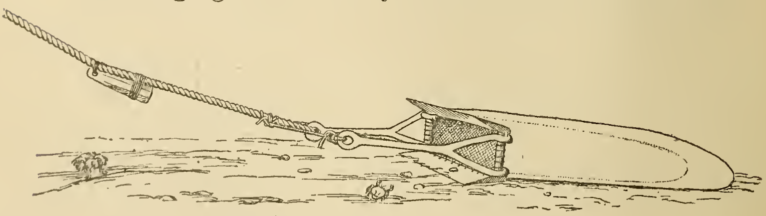
On the line between high and low tide many genera of Echinoderms are found thrown upon the beach. Several Holothurians are found by digging in the flats.

The hydroids of jellyfishes and many of the Actinozoa occur in sheltered pools or caves just below low tide, and can easily be captured with a hand-net by a little wading. I have found the roots of our large Laminaria, or "Devil's Apron String," when placed in pure water and allowed to stand for a length of time, to give up a rich collection of young starfishes, some young Holothurians and many Ophiurans. Hydroids are abundant on certain seaweeds washed on the shore after a storm. It is well to transfer to our aquarium any object which when thrown on the beach has apparently been recently torn from the bottom or has the appearance of having been floating for a considerable time. These objects almost invariably will be found to be the home of a rich cœlenterate life.

B. Dredging.

The use of the dredge for the capture of the adults with ova cannot be neglected. The great majority of the adults and some of the young are taken in this way.

For dredging down to fifty fathoms, which is the limit



DREDGE FOR USE IN SHALLOW WATER.

of the animals treated of in this volume, a very simple dredge can be constructed by any blacksmith, and with a rope suitable for that purpose, will cost only a few dollars.

The dredge which I have used consists of a rectangular

frame made of iron of about twice the length of the height. The longer sides are made of flat bars which are more or less flaring. The rope is attached to two iron arms which move readily on their attachment to the frame and which have eyebolts at their free ends. The rope is firmly attached to one of these; the attachment to the other is by means of a smaller cord which will break when the dredge is caught, and allow the obstruction to be avoided by a change in the direction of the dredge. A weight is fastened to the dredging rope about five feet or a fathom from its junction with the dredge, to insure success in the dredge being dragged along horizontally. The length of the rope used must be somewhat longer than the depth of the sounding, and may be determined by the various conditions, as depth of the water, or time of the tides. The simple drifting of the large sail boat is force enough to work with a small dredge.

The net of the dredge is fastened to the iron frame, and is protected by a coarse canvas bag which prevents the meshes from being torn. The time the dredge may be left out must be determined by experience.

The most convenient place[1] for shore collecting is at Revere Beach and Nahant. The piles of Beverly Bridge furnish many Actinoids and Hydroids.

The dredging off Nahant is among the best in New England. Off Race Point, Provincetown, a rich harvest may be expected. The channel between Castle Hill and Conanicut Island is rich in certain genera, especially Arbaciæ and Echinarachnii. Dredging off Baker's Island is good.

The ledges in the middle of Plum Island river off Great Neck, Ipswich, and the adjoining deep water are good places for Asteroids and Echinoids.

Grand Manan is one of the best collecting places for lit-

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[1] This is written for teachers living near Boston.

toral and shallow water animals on our coast. The "ripplings" furnish one of the best places for surface genera. At Eastport the channel between the Old Friar and Treat's Island is the richest known to me. The surface fishing there is good. Newport affords an abundant surface fauna which is characteristically southern in its facies.

Surface fishing, as distinguished from shore collecting and dredging, pertains to those animals which habitually swim at or very near the surface of the sea.

The fauna of the ocean surface is known as the pelagic fauna, from the Greek word, πέλαγος, meaning the sea. Since, however, the word pelagic from its derivation means the sea as a whole without special reference to the surface, the adjective æquorial, from "æquor" the surface, would more accurately designate the character of the fauna with which a part of our subject deals.

The methods of surface fishing are easily acquired and require no complicated outfit. A simple hand or drag-net made of muslin or bolting cloth for collecting; a water bucket or jar for the reception of specimens captured; and a boat to seek out the tide eddies where the animals which we are to study are most common, are all that is necessary. This method of fishing needs but a few general hints for successful prosecution.

The best collecting ground must be learned from experience. Tide eddies, edges of currents, sheltered nooks and small bays into which the floating life is accidentally lodged or driven by the wind and tides, are most prolific in the abundance of surface life. Wherever the tidal currents collect flotsam of any kind, there, if not too far from the open ocean, one can look with promise of success for wealth of æquorial life. The same causes which bring inanimate objects into these places will lead to accumulation of floating forms of life in the same localities.

The time for profitable collecting is influenced by the

tides, the winds and some unknown conditions. Other things being equal, at the mouth of a bay as at Newport the full tide is best for oceanic larvæ, or if one is situated near a small bay where floating material is caught during an ebbing tide, about an hour after the tide begins to fall will generally yield the best results. The first hour of the flood is commonly the poorest time for surface collecting and the last of the ebb generally gives us the larvæ of the littoral fauna rather than the oceanic. The best condition of the sea in which to collect surface animals, adult as well as larvæ, is during a calm. When this happens in Narragansett Bay at high tide, after a strong south, or southeasterly wind we may, if ever, expect to find a most abundant and varied life captured in our nets. Smooth places on the surface called "slicks" afford good collecting. Night-time during that calm state of the water which commonly takes place between eight and nine o'clock, is one of the best hours for successful surface fishing. The amount of "phosphorescence" in the water is an indicator of the abundance of surface life. The character of the animal life which causes the glow can be in a measure made out by the color of the emitted light.

As most of the larvæ which are treated of in these chapters are very minute, almost invisible when swimming in the sea, it is often necessary in collecting to drag the net about apparently at random, "skimming" as it is called the surface of the water, and then lightly washing off into the water of the collecting jars the small animals which although not seen have been caught on the meshes. An examination of the capture for identification must be made in a more favorable time and place than at night in the boat. The water into which the animals have been washed from the drag-net is commonly placed in glass dishes over a black background (tile preferred) and allowed to be-

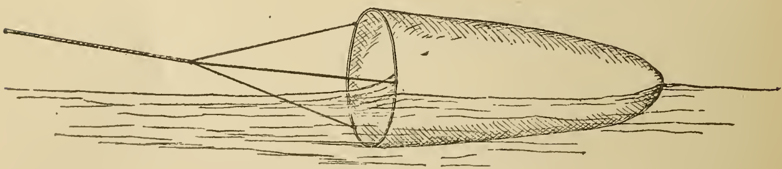
come quiet. It is well also to place the dish in such a way that direct light shines on one side in order to look through it from the other. The black ground and the light passing through the water make it possible to detect more easily sm al swimming larvæ. Commonly also, when the water in the dish is quiet, the minute embryos and larvæ come to the surface and can be seen and easily picked out with a pipette, from which they are transferred to a "live box," or watch crystal for study.

The present work goes no farther than the identification of the larvæ. Their method of treatment as objects of embryological research with reagents and with the microscope belongs to another chapter of marine zoölogy. Those who seek in these pages a faunal catalogue will find many omissions. I have tried to write an introduction to the fascinating study of the adult and larval stages of the lower animals which are found in our bays.

C. Collecting Surface Animals.

(with tow or dip-net.)

The animals which constitute the surface fauna are obtained by what is called a towing-net. The towing-net is a bag made of strong linen or bunting and is dragged



TOW-NET FOR ÆQUORIAL ORGANISMS.

through the water after the boat. The mouth of the net is kept open by a metallic ring to which the mouth of the net is fastened. The net should be about a foot deep, and

the diameter of the ring of wire possibly twenty inches. The wire should be large enough not to be bent under a considerable strain.

Three pieces of line about the size of cod-line and about two feet long are fastened at equal intervals in the ring. These are all joined at one end and attached to the towing-line. Enough of the towing-line should be let out to cause the net to work just below the surface. The length of the towing-line must be learned from experience.

The towing apparatus, thus rigged, is used in the following way: After the net is thrown over the stern of the boat, a moderate headway is given to the boat. The length of time the net must be dragged is regulated by the abundance of surface life. Care should be taken that the headway of the boat is not lost, as in such a case the animals are washed out of the net. To obtain life from zones below the surface the net can be weighted by a weight determined by the length of the tow-rope, the velocity of the boat and other circumstances. Care should be taken, if the direction of headway is changed, that the net is always kept distended in its original direction. When there is a coastward current under a bridge, the towing-line may be fastened to the bridge and the force of the current utilized to distend the net.

a. Freeing the net of its collections.

The net is hauled on board and the contents simply washed into a pail of pure water by turning the net wrong side out. An ordinary water bucket is a good collecting vessel. For detection of the specimens the best plan is to use glass vessels over a black ground. Mr. A. Agassiz uses flat glass pans over a table of black tiles. Allman recommends a white glazed earthenware pan such as is used in dairies for holding milk. If the bowl is placed in a deep

glass jar or finger bowl so that the light passes through it, small animals can be detected through the sides. Most of the small animals seek that side of the vessel on the surface turned to the light and one can easily find them there. Small glass finger-bowls in which larvæ can be raised, can be examined by holding them between the light and the eye. The animals may be picked out by pipettes or tubes. The water in which the animals are first placed, if crowded with life, soon becomes vitiated. When few animals are found they can be left in the pan in the same water in which they were captured. It is a good plan to add in such cases some pure water, and keep in the pan small genera of bright green algæ.

b. Collecting surface animals by observation in the water.

Although the dip and the drag-net yield the best results, it is often necessary to see the animals in their native habitat, in order to pick out what is wanted. The surface is often so crowded with Salpæ, for instance, that the net gets clogged with them, and a person in search of anything else cannot use the net to advantage.

If the sea is very smooth, very small animals can be detected by the eye from the boat. I have used a water-glass with advantage. The fishermen in Villa Franca, southern France, carry a bottle of oil in the boat and use oil to quiet the surface. A blackened plate of tin, lowered in the water, renders it possible to detect very small animals in the water above it. When once detected, it is not difficult to capture the animal with glass dishes or hand nets.

c. Places for collecting surface animals.

The best localities must be learned from observation. Tide eddies are favorable points, and the water in the vicinity of floating masses of seaweed is sometimes crowded

with life. The time of day seems not to matter but the tide is a great factor. At low tide we expect littoral, at high tide pelagic animals. At night conditions are favorable at about half-past eight when the sea appears calm. Calm weather is a desideratum, and a glassy calm is a very favorable opportunity.

In night-fishing an incandescent electric light may be hung at the mouth of the net to attract animals. The color of the phosphorescence corresponding to different animals must be learned by experience.

III. CŒLENTERATA.

The animals of this group have a great variety of external outlines, but several common anatomical likenesses. In their simplest form the bodies consist of a simple gelatinous bag, fixed to the ground or free-swimming. There is an opening called the mouth at one pole, while the whole cavity of the sac serves as a stomach or is in free communication with the exterior medium through the mouth-opening. In most of these animals the body cavity is continuous with the stomach. In many there is no body cavity except the stomach, a characteristic which has given the name of Cœlenterata to the group.

Rising higher than the simple sac, whose walls serve as the linings of a stomach and whose opening is a mouth, we pass to those where thread-like organs called tentacles, which serve to capture food, are placed in a ring about the mouth, and higher still to those where portions of the body walls are inflated into a bell-like structure for locomotion. Here we find added also sense capsules and complicated sucker-like oral appendages, the modifications in which will be more minutely described in considering the different genera. These organs generally take a radial arrange-

ment about the polar mouth opening. It was that radial symmetry which Cuvier first recognized and which led him to unite these animals with others in the group of Radiata.

The Cœlenterata include the Medusæ and Actiniæ. While these animals have much in common in their anatomical structure, their external resemblances are oftentimes very distant. Compare, for instance, the filmy, gelatinous body of the jelly fish and the hard, stony coral as we see it in our museums. Yet the calcareous and other hard secretions of the body of the coral once removed, the soft parts which remain betray anatomical peculiarities of the stomach and body cavity already mentioned, and therefore close resemblances to jelly-fishes.

The Cœlenterata are divided into the Hydrozoa, Ctenophora and the Actinozoa. The two former groups, known as the jelly-fishes, are well represented by their larvæ in the surface waters of New England, while only a few forms of the latter occur, or come within the scope of this account. While the larvæ of some Actinozoa inhabit the surface waters, there are few genera in Narragansett Bay as compared with the other groups.

Class I. Hydrozoa and Ctenophora.

(*Jelly-fishes.*)

These animals have hyaline, gelatinous bodies; live solitary or united in colonies; bodies bell-shaped, tubular, mushroom-like, cup-shaped, or resembling a floating bag or disk. When bell-shaped, a fleshy protuberance of folded membrane hangs down from the under side and serves as the stomach. The centre of the body is occupied by a cavity out of which slender tubes or vessels radiate to the bell-margin. These vessels may be united by a circular tube about the periphery or may end blindly

near the rim. They sometimes pass directly from centre to rim, at other times subdivide, bifurcate and coalesce. Different tubes in the same bell may have a straight or a tortuous, or a marginal course. The movement of a nutritive fluid in the tubes can be seen through the bell-walls. Bell-cavity present or wanting. When present, it is sometimes partly closed at its entrance by a washer-like body called the velum.

The bell margin of the Hydrozoa is either entirely crenated, slightly notched or scalloped. Small, transparent cells, the sense capsules, otocysts, with enclosed calcareous grains called otoliths, are commonly present. The number and structure of these organs vary in different genera. In the Hydrozoa, when present they are placed around the bell margin and their number is from four to sixteen; in the Ctenophora there is, in the adult, a single polar sense capsule. The sense-capsules of the former group are partially covered on the upper side by a small, gelatinous lappet which is called the "hood." Jellyfishes which have a hood are called the "hooded-eyed"; those without, the "naked-eyed" Medusæ.

Small, thread-like bodies, called tentacles, varying in number and size, hang down singly or in clusters from the under side of the body at or near the bell-margin. In those genera (Ctenophora) which have a single polar sense capsule opposite the mouth, there are either two long tentacles with side branches with numerous smaller body filaments, or these structures may be wholly wanting.

These animals are generally small, transparent, phosphorescent in darkness when the water is agitated. Many are highly colored. Water forms the great mass of the body substance. Their larval forms are among the most abundant animals found on the surface of the ocean. The Hydrozoa are classified as follows:

Order I. Hydroida. Bell-shaped bodies, without flap

(hood) over the sense capsules and with or without marginal sense bodies; with bell-cavity, the entrance into which is partially closed by a velum.

Order II. Trachymedusæ. Bell-shaped, often disk-like bodies. Four or eight sense capsules with or without hood. Bell-cavity with velum.

Order III. Siphonophora. Tubular or bag-like bodies. Many individuals of different shape and function united in a colony. With or without bell-shape and gelatinous appendages. When present, these resemble those of Hydroida.

Order IV. Acraspeda. Disk-shaped bodies with four, eight or sixteen marginal sense-capsules. No bell-cavity. No velum.

Order V. Ctenophora. Single polar sense-capsule without hood. Locomotion by means of eight meridional rows of vibratile flappers on outside of body.

Order I. Hydroida (free).

A. Without sense capsules; sexual organs never free from the base of the proboscis.

I. Tubes four, unbranched.

No tentacles	Pennaria.
One tentacle	Hybocodon.
Two tentacles	Stomatoca.
	Dinematella.
Four tentacles	Sarsia.
	Dipurena.
	Ectopleura.
	Zanclea.
More than four single tentacles.	Turris.
	Dysmorphosa.
	Staurophora.
	Calicopsis.
	Modeeria.

Four clusters of tentacles . . Nemopsis.
Eight clusters of tentacles . . Lizzia.
II. Tubes four, branched . . . . . Willia.
III. Tubes eight, unbranched . . Melicertum.
Mabella.

B. With sense capsules ; sexual organs suspended from radial tubes.

I. Tubes four, unbranched.

a. Stomach without peduncle.

Tentacles numerous, without smaller basal "spurs."

Obelia.
Oceania.
Clytia.

Tentacles numerous, with basal "spurs."

Eucheilota.

b. Stomach with peduncle.

Tima.
Eutima.

II. Tubes numerous.

Zygodactyla.

A. I.

Pennaria. Bell ovate; tubes four, broad. Tentacles slight projections of the bell-margin at the junction of the radial and circular tubes.

P. gibbosa.[1]

Hybocodon. Bell globose, asymmetrical. Tubes four, slender. Single tentacle generally with a cluster of budding Medusæ at its base.

H. prolifer.

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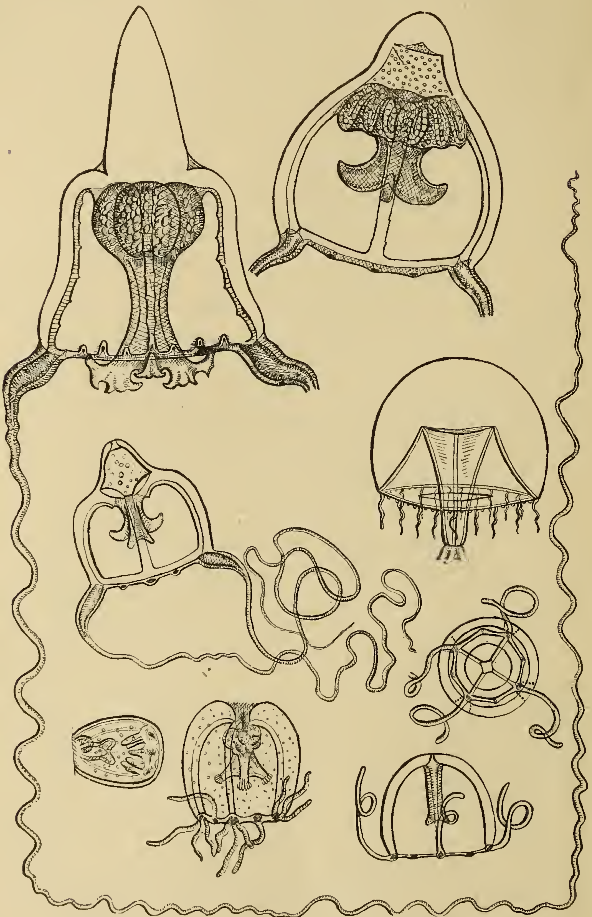
[1] Authorities for specific names are given in the index at the end of the paper.

Stomatoca. Bell oval, with tall, conical, apical projection. Tubes four, broad, often with jagged edges. Tenta-



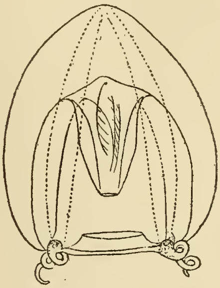
STOMATOCA. DINEMATELLA.
YOUNG DINEMATELLA. YOUNG TIMA.
YOUNG LIZZIA. CALICOPSIS.

cles two, opposite, long, very flexible. Their bases have a claret-red color. Proboscis trumpet-shaped, swollen near

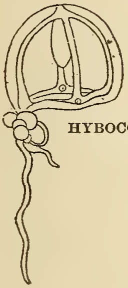
the bell. Lips flange-like, extending barely outside the bell-opening.

S. apicata.

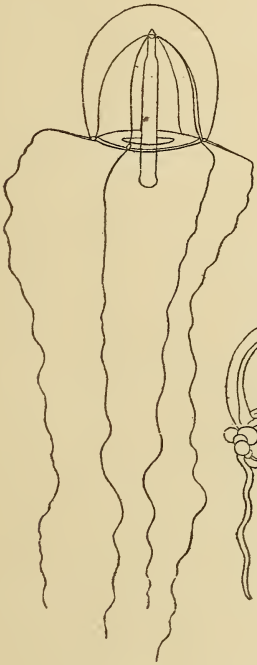
Dinematella. Bell ovate, with tall, conical, apical projection in which is found a cavity shaped like the frustrum of a cone, and which is in free communication with



ECTOPLEURA.



HYBOCODON.



SARSIA.

that of the proboscis. Tubes four, with jagged edges, broad. Tentacles two, opposite, long, flexible. On the bell-rim between the long tentacles are situated small tentacular processes with pigment spots. Proboscis large, swollen at base, light-cream color.

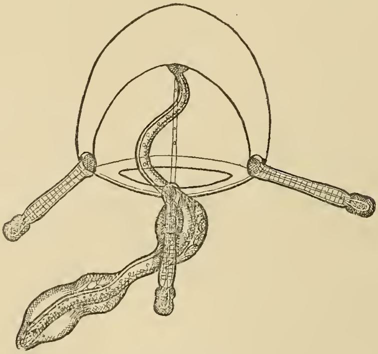
D. cavosa.

Sarsia.[1] Bell oval. Tubes four. Tentacles marginal, four, long, flexible, each with a single bright red pigment spot on under side of base at the extremities of the vessels. Proboscis very long, highly contractile; when expanded the extremity reaches far outside the entrance into the bell-cavity. Lips simple, ovaries inconspicuous.

S. mirabilis.

Dipurena. Bell half egg-shaped. Tubes slender, four. Four stiff, short tentacles with an enlarged club-shaped distal extremity. Eye-spot at the basal end. Proboscis very long, with large swellings crowded with ova in female. Lips simple.

D. strangulata.



DIPŬRENA.

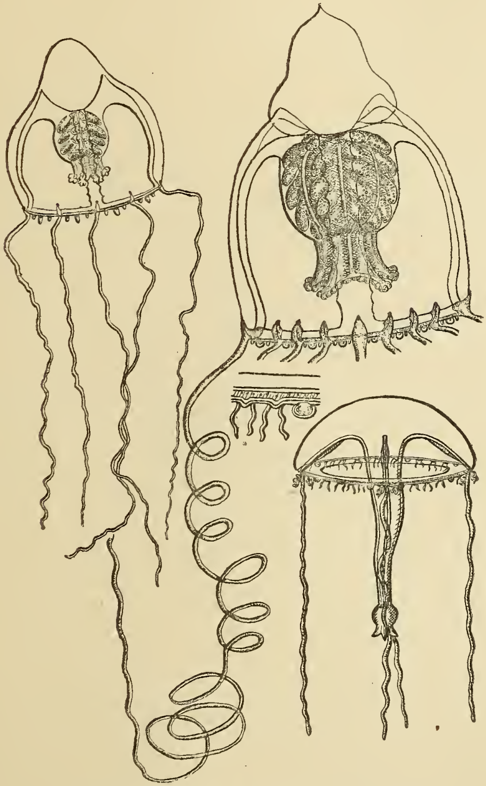
Ectopleura. Bell ovate with a slight apical projection. Tubes four. Eight rows of lasso-cells arranged on the outer wall of the bell in pairs, each pair arising from the base of a tentacle and extending to the apex of the bell. Tentacles four, generally coiled about their origin at the bell rim. Each tentacle in adult with clusters of lasso-cells at intervals in its length. Proboscis two-thirds the height of the bell cavity. Lips simple.

E. ochracea.

[1] Closely related to this is the free form of Hydrichthys which is attached to wall of fish *Seriola zonata.*

Zanclea. Bell oval, with slight apical prominence. Tubes four. Tentacles four, each with lateral branches formed of a small pedunculated cluster of cells. Proboscis extends to opening into the bell-cavity. Bell walls with cluster of lasso-cells above the origin of the tentacles from the margin.

Z. gemmosa.



YOUNG TURRIS. TURRIS.
OTOCYST OF EUTIMA. EUTIMA.

Turris. Bell mitre-shaped, with apical prominence. Tubes four. Tentacles numerous and of two kinds. The

longer bear eye-spots at their very origin from the bell-margin; the latter from a point a little above the rim. Proboscis large, swollen at the base. Mouth trumpet-shaped. Lips complicated.

T. episcopalis.

Dysmorphosa. Bell ovate with slight apical prominence. Tubes four. Tentacles numerous. Proboscis of medium size, with four spherical ovaries at base. Lips have a "frosted appearance" on account of the clusters of lasso-cells.

D. fulgurans.

This genus is said to occur in New England. See A. Agassiz, "Sea Side Studies." I have never collected it.

Staurophora. Bell disk-shaped, cream colored, with flexible walls. Tubes, four. Tentacle numerous, so crowded together that their bases at the union with the bell margin touch each other. Tentacles short, flexible, with single eye-spot at union with bell-rim. In addition to tentacles, small club-shaped bodies likewise arise from bell rim. Ovaries depend in part from the tubes in that half nearest the proboscis and from the proboscis.

S. laciniata.

Calicopsis. Bell ovate or globose. Tubes, four. Numerous short tentacles. Four ovaries at base of proboscis. Lips with four clusters of lasso-cells which impart a "frosted appearance" to them.

C. typa.

Modeeria. Bell mitre-shaped with apical projection, and thin walls. Tubes four, broad, with jagged edges. Tentacles numerous, flexible. Proboscis long, much swollen at the base. Lips simple.

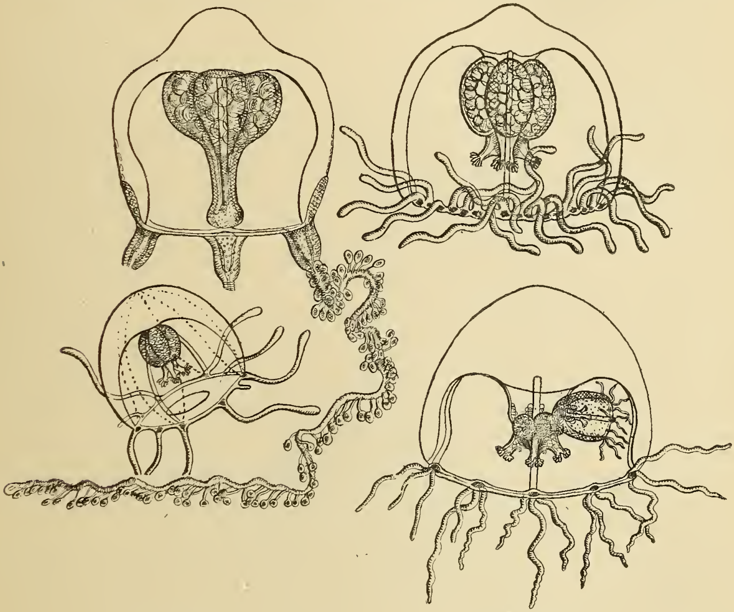
M. multitentacula.

Nemopsis. Bell oval. Tubes, four, broad. Tentacles in four clusters, each cluster situated at the union of radial

tubes and bell margin where there is a tentacular bulb with a row of pigment spots. Ovaries from tubes and proboscis. Proboscis short, with four oral dendritic tentacles.

N. Bachei.

Lizzia. Bell oval with apical projection and lower wall thin. Tubes, four. Eight clusters of tentacles from the



ZANCLEA. YOUNG CALYCOPSIS. MODEERIA. LIZZIA.

bell-rim. Four of these have five tentacles in each cluster and arise from the margin of the bell near the radial tubes and the remainder of three each alternate with these. Proboscis short, generally with budding young on its sides, with a quadrate mouth, each angle of which bears two clusters of lasso-cells.

L. octopunctata.

A. II.

Willia. Bell disk-like with small clusters of lasso-cells at intervals on the external walls. Tubes branched, four at origin from the proboscis.

W. ornata.

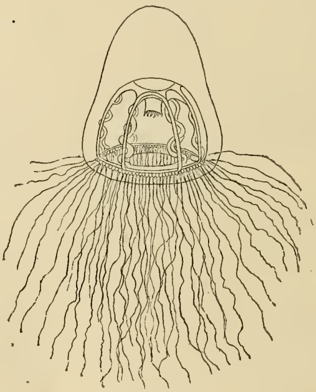
A. III.

Mabella. Bell globose. Tubes eight. Tentacles numerous, short, flexible. Proboscis small with lateral buds.

M. gracilis.

Melicertum. Bell oval, tall, mitre-shaped. Tubes eight. Tentacles numerous, long and very flexible. Proboscis with complicated lips. Tubes with ovaries along their whole length.

M. campanula.



MELICERTUM.

B. I, *a.*

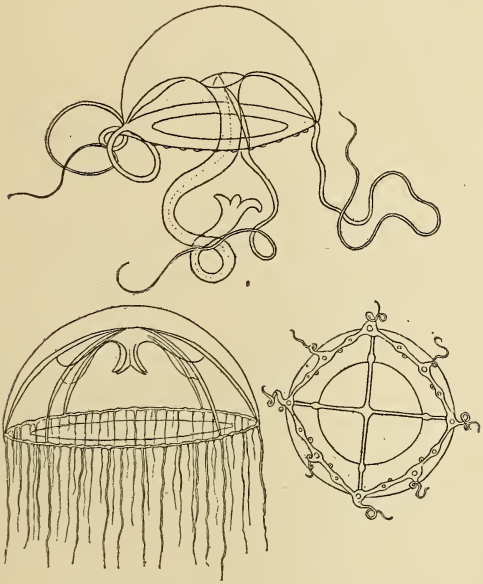
Obelia. Body disk-shaped, transparent, colorless. Sense-capsules with numerous otoliths, arranged at irregular intervals about the bell rim. Numerous rigid tentacles. Four tubes. Ovaries spherical, pendent from the tubes. The bell o ten reversed, and turned in such a

manner that the proboscis appears to arise from its convex side. Velum narrow.

O. gelatinosa.

Clytia. Bell disk-shaped, transparent, colorless. Tubes four. Tentacles numerous. Sense-capsules, eight. Tentacular bases thickly pigmented. Proboscis short, lips simple.

C. bicophora.

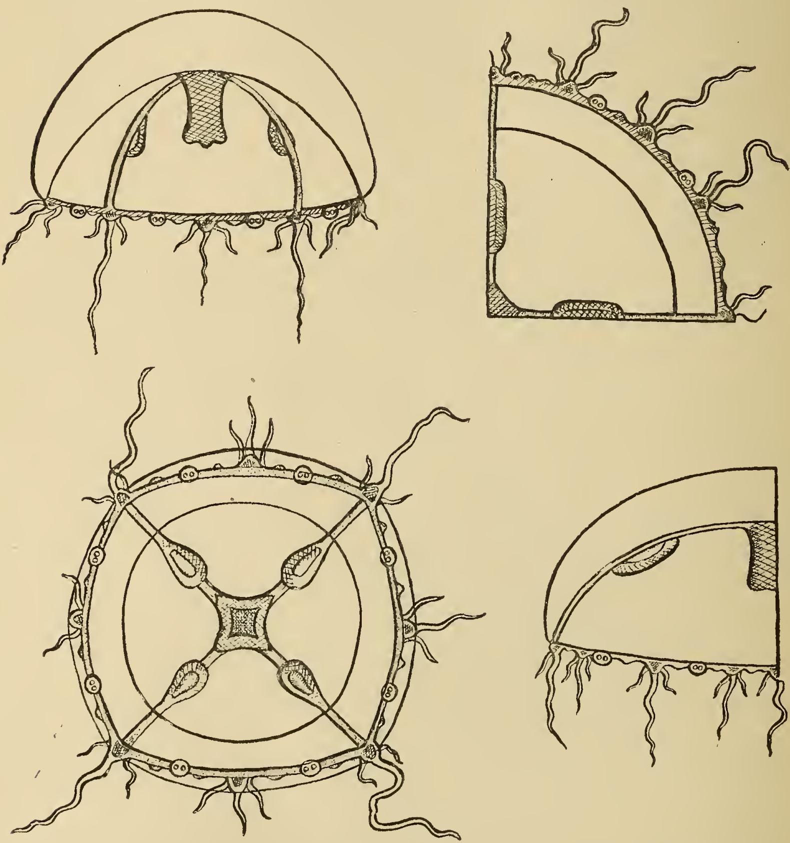


STAUROPHORA. LIRIOPE. CLYTIA.

Oceania. Bell, very flexible, disk-shaped, transparent, and moves with a languid motion. Four tubes with elongated ovaries. Tentacles numerous, thread-like, flexible. Proboscis short. Ovaries found on the peripheral two-thirds of the radial tubes.

O. languida.

Eucheilota. Bell disk-shaped, flexible, transparent. Tubes four. Ovaries spherical, hanging from the tubes. Sense-capsules, eight. Tentacles of two kinds, eight long,



YOUNG EUCHEILOTA. EUCHEILOTA.

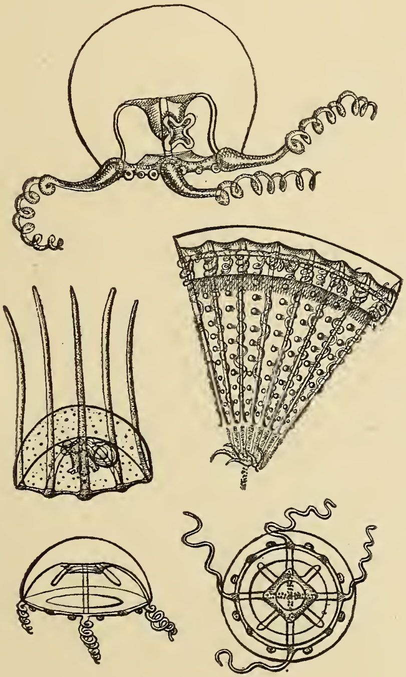
and sixteen small; shorter called spurs. Each long tentacle has a pair of spurs. Tentacular bulbs pigmented.

E. ventricularis.

B. I, *b.*

Tima. Bell hemispherical with thick walls. Tubes four. Tentacles, numerous, long, flexible. Ovaries ribbon-shaped on the tubes. Sense-bodies, numerous. Stomach mounted on a transparent peduncle. Lips, four-parted, margin with clusters of lasso-cells.

T. Bairdii.



SPHÆRULA.
MABELLA. SECTOR OF ZYGODACTYLA.
YOUNG ZYGODACTYLA.

Eutima. Bell oval, with thin walls, flexible. Tubes four. Tentacles of two kinds; four long at extremity of the tubes; pairs of small tentacles at intervals about the bell margin. These latter also accompany the long tentacles and may be called spurs. Stomach mounted on a slender

peduncle which extends far outside the bell opening. Lips quadrate. Ovaries ribbon-like on tubes and base of peduncle.

E. gracilis.

B. II.

Zygodactyla. Bell disk-shaped, cream colored, also pinkish. Tubes numerous with ribbon-shaped ovaries. Tentacles numerous, short, very flexible, generally coiled. Sense-capsules numerous. Proboscis finger-like folds of a delicate membrane which seldom closes forming the mouth opening. Rows of small tubercles on the walls of the bell-cavity between the chymiferous tubes.

Z. Grœnlandica.

Free-swimming larvæ.

A. I.

Pennaria gibbosa. The young Pennaria closely resembles the adult. This stage is rarely found free-swimming on the surface, although if a colony of the hydroids be kept in a glass jar for a short time, the buds if mature easily drop off and swim away.

Hybocodon prolifer. The larvæ of this medusa can best be studied by a comparison of the different medusa buds found on the tentacular bulb of the adult. Free forms are extremely rare and after they attain the stage when they separate, their resemblances to the adult are very close.

Stomatoca apicata. Larva like adult with tall bell which, however, is destitute of apical prominence. Tubes four, broad. Tentacles, two, opposite, long, very flexible. No little tentacular projections on the bell-rim between the tentacles. Proboscis shorter than in adult, extending to the bell opening.

Dinematella cavosa. Larva without apical projection on bell apex. Cavity at base of the proboscis small, want-

ing. Small finger-like projections on the bell margin wanting. Color of larva like that of adult.

Sarsia mirabilis. Larva resembles adult.

Dipurena strangulata. Larva not studied.

Ectopleura ochracea. Larva like adult.

Zanclea gemmosa. Bell ovate without apical prominence. Tubes four. Tentacles two, each with numerous lateral branches. In some young forms the two additional budding tentacles are seen. Bell with clusters of thread cells as in adult.

Turris episcopalis. Larva with characters of adult.

Dysmorphosa fulgurans. Larva not observed.

Staurophora laciniata. Larva like adult.

Calicopsis typa. Larva like adult.

Modeeria multitentaculata. Larva not observed.

Nemopsis Bachei. Larva has few tentacles in each cluster. Dendritic labial branches less complicated.

Lizzia octopunctata. Larval forms of Lizzia in all stages of growth found on the sides of the proboscis. The young can be studied from these buds. 1. Youngest bud has single tentacle at each end of the radial tubes and single intermediary tentacle. 2. The next oldest has a cluster of three tentacles at end of each tube and three intermediary in cluster. 3. Oldest with five tentacles at the end of each tube with three in intermediary clusters. The stages 2 and 3 are free, and have rudiments of the second generation of buds on the outside of proboscis. The very immature buds also found in younger stages have half formed probosces.

A. II.

Willia ornata. Larva with four tentacles one at each end of the four unbranched tubes. Alternating with these on the bell walls a small cluster of nematocysts. Apical tube visible.

A. III.

Mabella gracilis. Larva not observed.

Melicertum campanula. Larva like the adult.

B. I, *a*.

Obelia diaphana. Larva like adult.

Clytia bicophora. Larva in youngest form with two tentacles opposite each other and eight otocysts.

Oceania languida. Larva in youngest form with two opposite tentacles, four otocysts. Proboscis small, inconspicuous.

Eucheilota ventricularis. Larva like adult.

B. I, *b*.

Tima Bairdii. Larva like adult. Tentacles short, numerous. Proboscis small. Otocysts like adult.

Eutima gracilis. Larva not observed.

B. II.

Zygodactyla Grœnlandica. Larva in youngest form found with four tubes, four tentacles. Numerous otocysts. Next oldest larva has four complete tubes and four additional tubes extending half way from junction of proboscis and bell margin.

Order I. Hydroida (attached).

Many of the jelly-fishes originate as buds from an attached zoöphyte known as a hydroid. To become familiar with the different forms of the young of the Hydrozoa, it is necessary to be able to identify these animals.

The fixed hydroids are algæ-like organisms, simple or branching, with soft or hard axis. They are solitary or social, and give rise to medusæ by budding or by processes resembling fission.

Athecata.[1]

Without thecæ for hydranth or sexual bodies.

A. Forming calcareous encrustations. . Hydractinia.

B. Erect, plant-like, not parasitic.

I. Solitary.

a. Tentacles capitate, scattered over the body . . . . Acaulis.

b. Tentacles filiform, in two circles. Corymorpha.

II. Associated.

a. Tentacles of one kind.

Tentacles capitate in single whorl. Clavatella.

Tentacles filiform.

a. Two separate rings of tentacles with free medusæ. Ectopleura.

b. Two tentacular circles without medusæ . . . Tubularia.

c. Scattered, with hydranth on branch of stem . . . . Tubiclava.

b. Tentacles in single verticil, without bosses.

Polyps sessile . . . Podocoryne.

Polyps on stem, with trumpet-shaped proboscis . . . . Eudendrium.

Hydranth without covering, with conical proboscis. Gonophores on cœnosarc.

a. Arborescent . . Bougainvillia.

b. Small, simple habit. Perigonemus.

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[1]Thecæ, or cups surrounding the hydranth or stomach with a crown of tentacles about a mouth. Athecata; ἀ, θῆκα, without a cup. Thecaphora; θῆκα-φέρω, cup bearing.

b. Tentacles of two kinds.

Upper, capitate; lower, rigid in single verticils . . . . . Cladonema.

Upper, capitate; lower, filiform in several verticils . . . Stauridium.

c. Tentacles in several whorls.

Capitate without free medusæ. Coryne.

Capitate with free medusæ. Syncoryne.

C. Parasitic on *Seriola zonata* (osseous fish). Hydrichthys.

No tentacles, two kinds of individuals. Hydroid reduced to a botryoidal cluster of medusæ.

Thecaphora.

Hydroids with hydranth and sexual bodies enclosed in a cup.

A. Calycles[1] erect and free, hydranths retractile.

I. Calycles supported on a short process from the stem; hydranths partially retractile.

With tentacular organs over the cœnosarc. Ophiodes.

Without tentacular organs over the cœnosarc. Halecium.

II. Calycles bell-shaped.

a. Operculated . . . . . Lovenella.

b. Non-operculated.

Clytia.
Obelia.
Campanularia.
Thaumantias.
Gonothyræa.

---

[1]Cup-like structures, hydrothecæ, in which the hydranths are protected.

III. Calycles not bell-shaped.

a. Calycles conical, long . Campanulina.

b. Calycles with conical operculum, constricted at base; pedicellate. Calycella.

c. Sessile; not constricted at the base. Cuspidella.

d. Calycles without conical operculum, scattered . . . . Lafœa.

B. Calycles adnate, disposed along the stem and branches.

I. Without nematophores.[1]

a. Calycles cylindrical and disposed on all sides of stem . . . . . Salacia.

b. Calycles on creeping stem (not erect). Filellum.

c. Calycles in two series.

1. Alternate, with operculum. Sertularella.

2. Without operculum.

a. Gonothecæ with cleft margin and internal marsupium. Diphasia.

b. Orifice of gonotheca, plane; no internal marsupium.

With verticillate branches. Sertularia.

Without verticillate branches. Antennularia.

1. With mesial nematophore attached to part of calycle. Aglaophenia.

2. Without mesial nematophore. Plumularia.

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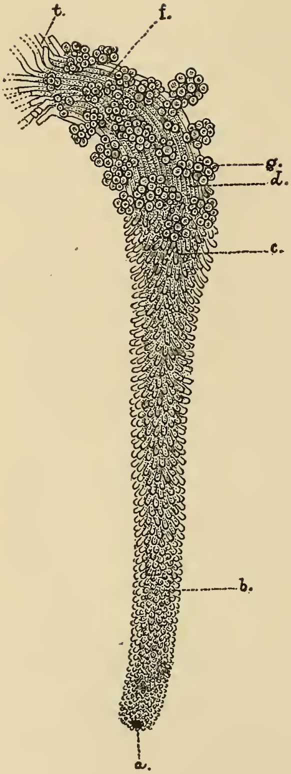
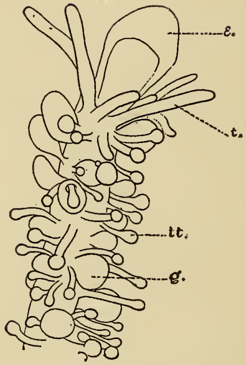
[1]Small cup-shaped structure resembling small calycles in which a protoplasmic thread-like body is found, and from the inner base of which it arises.





VIEW OF ANTERIOR END OF ACAULIS, SHOWING TEMPORARY TENTACLES *tt*.

ADULT ACAULIS. *a*, TERMINAL OPENING OF THE BODY—THE INTERIOR OF THIS BODY IS "DARK REDDISH PURPLE;" *b*, CENTRAL, PURPLE-COLORED BODY WALL; *c*, SMALL PAPILLÆ—THESE, AS WELL AS THE EXTERNAL BODY WALL, ARE LIGHT PINK; *d*, RIDGES OR FOLDS IN THE EXTERNAL WALLS OF THE BODY, OF A "WHITE COLOR;" *e*, TERMINAL CONTINUATION (UNATTACHED) OF THE BODY OF THE YOUNG ACAULIS; *g*, GONOPHORES—THE INTERIOR OF THESE CLUSTERS IS DARK PURPLE, THE EXTERIOR, WHITE GRANULAR; *t*, PERMANENT TENTACLES—"SUCTORIAL TENTACLES;" *tt*, TEMPORARY TENTACLES.

A.

Hydractinia. Clavate sessile filiform tentacles from a conical proboscis from the cœnosarc. Naked polypary. Some polypites are partially developed and bear spherical clusters of thread cells. No medusæ. Found on shell inhabited by Eupagurus, or on floating wood, spiles, etc.

H. echinata.

B.

Acaulis. Solitary, cylindrical, terminated above in a conical proboscis. Adherent. Tentacles scattered, small over whole body. Gonophores clustered about base.

A. primarius.

Corymorpha. Polypite solitary, in delicate sheath. Two sets of filiform tentacles. Oral tentacles in several verticils placed close together. Prominent proboscis. Roots attached in sand.

C. nutans.

Ectopleura. Stem delicate, slightly branched. Twenty-four oral; thirty lower tentacles. Medusæ developed between the two series.

E. ochracea.

B. II. *b.*

Tubularia. Stem simple and branched, rooted by a filiform stolon with inverted polypary. Filiform tentacles in two whorls. Gonophores on peduncles between two whorls of tentacles. Young has an actinula form.

T. indivisa.

Clava. Clavate, tentacles smooth, sheathed in chitinous polypary. Buds borne in clusters. No medusæ. On *Fucus.*

C. leptostyla.

Tubiclava. Erect stem with branches and creeping

stolon. Sheathed in chitinous polypary. Buds in clusters below lower tentacles. No medusæ.

T. cornucopiæ.

Podocoryne. Cœnosarc thick network; polypary forms a continuous crust which forms a small cup-like invest-

TUBULARIA. CORYMORPHA. CLAVA.

ment round the base of polypites. Single verticil of tentacles. Gonophores borne below the tentacles. Free medusæ. Gonosome bell-shaped. Short manubrium with oral tufts of thread cells. *P. carnea.*

Eudendrium. Stem branched with creeping stolon. Chitinous perisarc. Hydranths borne at the end of branches, vase-shaped. Single verticil of filiform tentacula. Gonophores from polypites below the tentacles or from the stem with fixed sporosacs.

E. dispar.
ramosum.
rameum.
cingulatum.
capillare.
tenue.

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Perigonemus. Cœnosarc chitinous. Stem branching with thread-like stolon. Single verticil of tentacles; gonophores developed from cœnosarc.

Medusa, *Stomatoca.*

Bougainvillia. Stem branched, rooted by filiform stolon. Cœnosarc with chitinous covering. Single circle of tentacles round base of conical proboscis.

Medusa, *Nemopsis* and *Bougainvillia.*

N. Bachei.

B. superciliaris.

Cladonema. Stem simple, slightly branched. Four capitate, tuberculate tentacles, from false tentacles which are stiff, and rounded at the extremities.

C. radiatum.

Stauridium. Creeping stolons, stem simple. Four whorls of cruciformly arranged tentacles, which are rigid, extending at right angle to the body.

Syncoryne. Stem simple or branched, rooted stolon wholy covered in tube. Medusa is Sarsia.

S. mirabilis.

C.

Hydrichthys. Parasitic on body walls of a fish. No tentacles; no terminal mouth opening. Sexual clusters, botryoidal.

H. mirus.

Thecaphora.

A.

Ophiodes. Stem, branching, base enclosed in cup; stolon root-like; non-retractile hydranths which are divided by a constriction into two regions. Webbed tentacles in a single verticil.

O. mirabilis.

Halecium. Plant-like, branched, rooted by creeping stolon. Hydrothecæ biserial, tubular, bell-shaped, subsessile, jointed to short lateral process. Hydranth partially retractile. Fixed sporosacs.

H. gracile.

Lovenella. Stem simple, branched, thread-like stolon. Hydrotheca turbinate, elongate, crowned with a conical operculum.

L. gracilis.

Clytia. Stem simple, branched slightly. Creeping stolon. Hydrothecæ bell-shaped. No operculum. Hydranths with large trumpet-shaped proboscis. Medusæ on stolon and stem.

Medusa, *Clytia.*

C. Johnstoni.

Obelia. Stem branching, plant-like, creeping stolon. Bell-shaped. No operculum. Gonothecæ on stem and branches.

O. gelatinosa.
commisuralis.

Campanularia. Stem simple, branched, filiform stolon. Hydrothecæ bell-shaped. No operculum. Hyaline. Hydranths with cup-shaped proboscis.

Gonophores fixed sporosacs, which mature in the capsule.

C. caliculata.

Thaumantias. Stem simple or branched, rooted to thread-like stolon. Calycles campanulate, with funnel-shaped proboscis.

Gonothyræa. Stem erect branching, thread-like stolon. Hydrothecæ bell-shaped, transparent. Proboscis prominent, contractile.

G. tenuis.

Campanulina. Stem slender, annulated. Calycles thin,

membranous, pointed, produced. Hydranths with webbed tentacles.

C. acuminata.

Leptoscyphus. Stem simple or branching, attached by a thread-like stolon. Hydrothecæ with operculum composed of convergent segments. Hydranths cylindrical with medusiform zoöids.

Medusa, *Lizzia grata?*

Lafœa. Stem simple, creeping tubular fibre, or erect and composed of many aggregated tubes rooted by a filiform stolon. Hydrothecæ tubular, sessile or with a short pedicel. No operculum. Hydranths cylindrical with conical proboscis.

L. robusta.

Calycella. Stem a creeping tubular fibre, erect, compound branched, rooted by a filiform stolon. Hydrothecæ tubular with an operculum formed of convergent segments or a plaited membrane. Hydranths cylindrical with conical proboscis. Fixed sporosacs.[1]

C. humilis.

B

Salacia (*Grammaria* Stimpson). Stem erect, composed of aggregate tubes, branching rooted. Hydrothecæ cylindrical, sessile, no operculum, adnate for part of length. Disposed on all sides of the stem in regular and equidistant longitudinal series.

S. robusta.

Filellum. Stem creeping, filiform, reticulate, immersed in chitinous crust. Hydrothecæ tubular, decumbent, adherent. No operculum, irregularly arranged along the stem to which they are attached by short stalk.

Sertularella. Plant-like. Stem branching, jointed,

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[1] Sacs in which the spores are contained; gonosac, sac containing the male sexual elements.

rooted by a creeping stolon. Hydrothecæ biserial, alternate, orifice toothed. Operculum of several pieces.

S. polyzonias.

Diphasia. Plant-like. Stem branching, jointed, rooted by a creeping stolon. Hydrothecæ opposite, pair on each internode. Valve-like operculum. Gonothecæ scattered, different in male and female.

D. fallax.

Sertularia (*Dynamena*). Plant-like; stem branching, jointed, rooted by creeping stolon. Hydrothecæ biserial, opposite or alternate. No operculum. Gonothecæ scattered.

S. pumila.

Antennularia. Plant-like. Stems simple or branching, with verticillate branchlets and rooted by a mass of fibres Hydrothecæ cup-shaped. Nematophores bithalmic on stem.

A. sp.?

Plumularia. Hydrothecæ sessile, unilateral. With nematophores or minute cups which contain an extensile offshoot from the cœnosarc, with or without nematocysts. Gonozooids fixed.

P. Verrillii.

Aglaophenia. Plumose, simple or branched, rooted. Hydrothecæ cup-formed. Nematophores on the Hydrothecæ. Gonothecæ in the form of corbulæ.

A. arborea.

Order II. Trachymedusæ.

Sense-bodies with a hood. With a bell-cavity and velum. * Medusæ transparent, of small size resembling in many particulars the Hydroida. Body disk-like, spherical, conical; colorless. Walls sometimes rigid, sometimes flexible. Marginal tentacles stiff, sometimes easily decid-

uous in single row. Often obscurely "hooded eyed." Proboscis and radial tubes generally present, often absent.

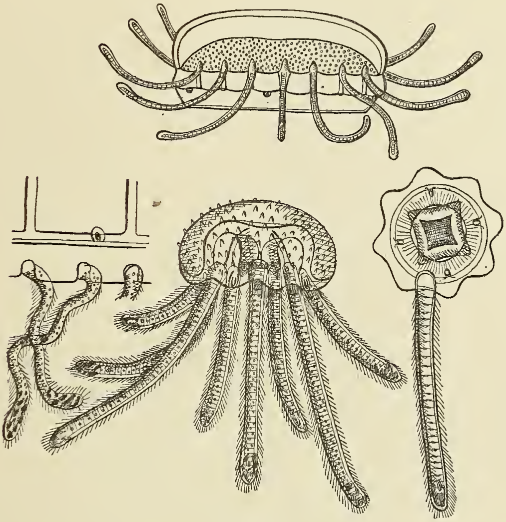
A. Without proboscis . . . . Cunina.

B. With proboscis.

I. Body-walls rigid . . . . . Trachynema.

II. Body-walls flexible . . . . . . Liriope.

Cunina. Body disk-shaped, inflexible, destitute of radial tubes. Tentacles rigid, arise from sides of the body



CUNINA.
SECTION OF THE BELL RIM OF TRACHYNEMA.
YOUNG TRACHYNEMA.

not from disk margin. Velum muscular, forming the lower floor of stomach-cavity.

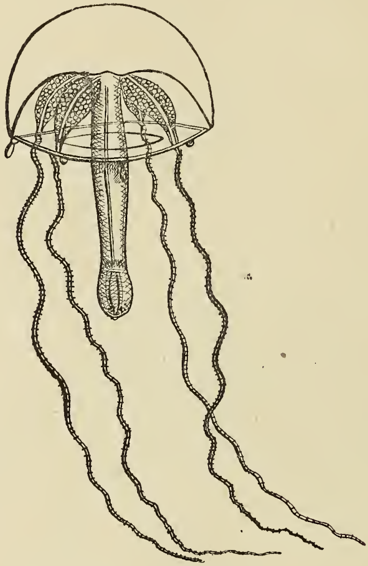
C. discoides.

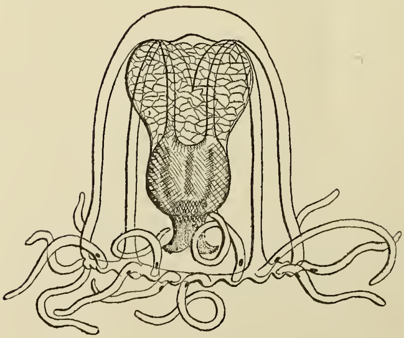
B. I.

Trachynema. Umbrella mitre-shaped with rigid walls, with quick spasmodic movements in propulsion. Onward motion caused in part by vibration of velum. Tentacles numerous with rigid bases. Eight radial tubes, generally

stump-like on account of deciduous extremities. Eight bright-red sense-capsules without covering lappets or "hoods." Proboscis pedunculated. Lips quadrate with numerous lasso-cells. Eight sausage-like ovaries hanging in bell-cavity from radial tubes.

T. digitalis.





LIRIOPE.
MODEERIA (TURRITOPSIS).

B. II.

Liriope. Body mushroom-shaped with flexible walls. Tentacles long, flexible, four in number. Four radial tubes. Proboscis pedunculated. Otocysts naked, with accompanying tentacular appendages. Ovaries on radial tubes, heart-shaped, slightly pendent from the inner walls of the bell.

L. scutigera.

Free-swimming larvæ.

The larval forms of the Trachymedusæ are very rare in Narragansett Bay. The youngest Trachynema which was found has a disk-shaped body, very obscure proboscis and eight tentacles alternating with eight otocysts. The surface of the body and the tentacles are ciliated.

C. discoides is a very rare medusa in New England waters and only two forms have been found; one with eleven and the other with fourteen tentacles.

Order III. Siphonophora.

Polymorphic medusæ generally with a tubular-formed body. With or without a float. With flask-shaped stomachs (polypites), from which depend long, contractile tentacles. Many have swimming-bells (nectocalyces), covering-scales and characteristic flask-like bodies called tasters. Colonies monœcious or diœcious. Reproduction by ova and by budding.

A. With a float . . . . Physophoræ.
  I. With an axis . . . . . . Agalmoides.
  Nanomia.
  II. Without an axis . . . . . Physalia.
B. Without a float . . . . Calycophoræ.

A. I.

Agalmoides. Body tubular, with colored axis, size of

a knitting-needle; float small. Nectocalyces arranged in two opposite rows on the third of the axis below the float, called the nectostem. Covering-scales flat, quadrangular in shape. Stomachs or polypites, arranged at intervals on lower two-thirds of the axis called polypstem. Tentacles long, contractile, dotted with lateral appendages (tentacular knobs). Each tentacular knob with pedicel; coiled cork-screw part (sacculus) covered by an involucrum; two terminal filaments and spherical vesicle. Ova and spermatozoa on the same individual or colony.

A. elegans.

Nanomia. Body tubular with colored axis; float small. Nectocalyces arranged in two rows on the third of axis. Covering-scales flat, quadrangular. Stomachs or polypites, on two-thirds the axis. Tentacles long, contractile, when retracted thrown into festoons. Tentacular knobs with sacculus, involucrum and single terminal filament. Ova and spermatozoa in respective bells on same colony.

N. cara.

A. II.

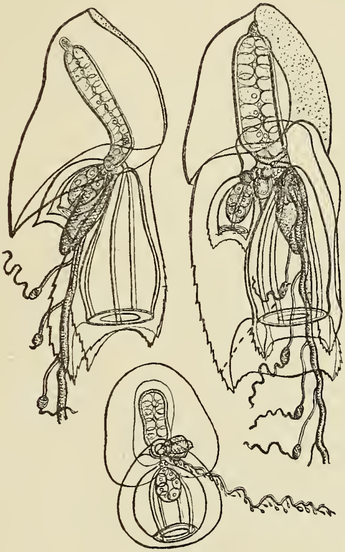
Physalia. Body bag-shaped, floating on the surface of the water, with appendages hanging down in the water on the lower side. Float pointed at one end with raised chambered crest on the upper side. Tentacles very long, contractile, armed at intervals with reniform thickenings of lasso-cells. Polypites numerous. Sexual bodies in the form of buds on a branching axis.

P. Arethusa.

Diphyes. Two small gelatinous nectocalyces placed end to end with openings into cavities pointing in same direction. Anterior conical, with four radial tubes of unequal length and single blind tube called the somatocyst in the bell walls on one side. Posterior bell with radial tubes of the same length, no somatocyst. Axis long, flexible,

with clusters of individuals at intervals. Sexual organs connected with these clusters.

D. formosa.



EUDOXIA LESSONII.
DIPLOPHYSA INERMIS.

Free-swimming larvæ.

Agalmoides elegans. The egg is dropped from the bells in the cluster of female sexual bodies and goes through its segmentation in the water.

There are three larval stages in the progress of the development which are called:

1. Primitive larva.
2. Athorybia stage.
3. Physophora stage.

All of these are found free-swimming in surface fishing; the first is rare, the second and third are taken almost

every summer in Narragansett Bay. The Physophora larva is the most common.

The primitive larva consists of a primitive polypite formed directly from the egg or budded from its side, a helmet-shaped covering-scale, the primitive covering-scale, or hydrophyllium, through which pass an unbranchal primitive canal and an embryonic tentacle with transitory tentacular knobs. The primitive larva swims at moderate depths in the aquarium.

The Athorybia stage has no primitive covering-scale, but a circle of serrated, provisional covering-scales, a transitory tentacle with tentacular knobs, a float, polypite, taster, and is destitute of nectocalyces. The axis from which the circle of serrated covering-scales in this larva arises is also probably transitory. The Athorybia stage is generally found free on the surface of the water.

The Physophora larva resembles closely the adult with the exception that it still retains the embryonic tentacle with its characteristic tentacular-knobs. Float and nectocalyces like those of the adult. The portion of the stem below the nectocalyces, called the polypstem, is enlarged at its very extremity somewhat as in the genus Physophora. Covering-scales like those of the adult are present, and the permanent tentacle with the knob characteristic of the adult coëxist with the embryonic. Both depend from the extremity of the stem opposite the float. A small cluster of immature buds just below the lower pair of nectocalyces are undeveloped polypites and tasters.

Physalia. The youngest Physalia has a float and polypite with a single tentacle. Of the very young Physalia little is known. There are no known provisional organs. The float is small, spherical or slightly oval in form.

The young stages of Diphyes have never been observed in Narragansett Bay, yet certain forms called the Diphy-

zoöids may be described here. A Diphyzoöid is a fragment of a Calycophore which has an independent life. Two forms of Diphyzoöids have been found in Narragansett Bay. They are known as *Eudoxia Lessonii* and *Diplophysa inermis.*

Diplophysa inermis. This species is the diphyzoöid of *Monophyes gracilis*, and in the cycle of development we have, according to Chun, stages corresponding with the following genera:

1. Monophyes.
2. Muggiæa.
3. Diplophysa.

Monophyes has not yet been recorded from New England. Muggiæa has been taken once or twice.

Order IV. Acraspeda.

Body or umbrella, disk-shaped. Sense bodies with a hood. Velum obscure. Without a bell cavity. Body gelatinous, flexible, convex above, generally colored. From centre of under surface hang long projections, or curtain-like folds, which enclose a stomach. Filaments (tentacles) arranged in bundles or simple rows around or near the disk margin. Sense bodies alternating with the tentacles on the bell rim, covered with "hoods."

A. Eight sense-bodies on umbrella margin.

Cyanea.
Aurelia.
Dactylometra.

B. Sixteen sense-bodies on umbrella margin.

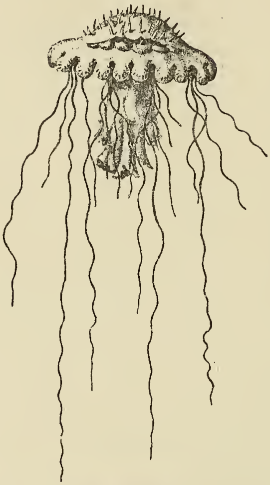
Callinema.

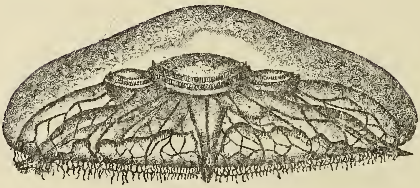
A. I.

I. Body red; mouth parts in folds; tentacles long, conspicuous, in clusters . . . . Cyanea.

A. II.

II. Body white; mouth parts four tentacular bodies; tentacles short, inconspicuous . . . . . . Aurelia.





YOUNG CYANEA.
AURELIA.

A. III.

III. Body pink; mouth parts in four long tentacular bodies; tentacles long, in series . . . . Dactylometra.

A.

Cyanea. Umbrella depressed with scalloped edges in which lie eight sense bodies, alternating with eight bundles of tentacles. Lips formed of curtain-like folds with

many ruffles. Chymiferous tubes dendritic. Color red and blue. Body very large.

C. arctica.

Aurelia. Umbrella disk-shaped with a single row of marginal tentacles. Eight hooded otocysts. Lips in the form of four fringed arms. Chymiferous tubes branched, not dendritic. Color cream or white. Body large size.

A. flavidula.

Dactylometra. Flexible umbrella, globular, discoid, with many marginal tentacles and incised edges. Lips in form of four long projecting tentacle-like appendages. Color pinkish; tentacles red. Tubes of body unbranched. No peripheral vessel.

D. quinquecirra.

B.

Callinema. Umbrella flat, thick with apical protuberance. Tubes radial, anastomosing in sixteen segments. Circular vessel with radial extensions. Sixteen sense lappets. Tentacles long, numerous, arising from circular vessel. Lips in curtain-like frills.

C. ornata.

Free-swimming larvæ.

The only free-swimming larvæ of Acraspeda yet described from New England are called the Ephyræ. Although other genera occur I have found only this stage of the two above-mentioned genera. The ova are borne in the folds of the mouth and their development into free planulæ can be easily traced into the sessile stages, Scyphistoma[1] and Strobila, descriptions of which do not come in the province of this work. The youngest free larva

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[1]Lucernaria, which is closely allied to Scyphistoma, has cup-shaped, very contractile body with peduncle and is found attached to Zostera or some similar foreign object. Tentacles small in clusters of tuft-like bodies. Color brown or light green.

between the Strobila and adult is called the Ephyra. The Ephyræ of Cyanea and Aurelia closely resemble each other; that of Cyanea is, however, a little larger than that of Aurelia and has a brown or reddish color. Both have a flat, disk-shaped body, deeply emarginated by sixteen incisions of two depths; in the more shallow of which the otocysts are placed, while a single tentacle is found as a mere stump in the deeper. The lips are very simple and without folds. In vibrations of the umbrella the marginal lappets are commonly raised above the aboral region of the bell and then brought suddenly down below the mouth.

A larval stage of Cyanea older than the Ephyra, which approaches in many particulars the form of the adult, is well marked on account of the great development of small filaments placed at intervals over the aboral region of the bell.

The larval stages of Callinema and Dactylometra are not known.

Order V. Ctenophora.

Free-swimming, gelatinous animals with spherical, thimble-shaped or ovate forms. The external walls of the body crossed by eight meridional rows of paddle-like flappers. With or without tentacles. Single, large, compound otocyst at one pole. Chymiferous tubes radially arranged. Without proboscis.

A. Ctenophora without tentacles (Nuda) . Beroë.

B. Ctenophora with tentacles (Tentaculata).

I. Body spherical, without lateral lobes. Rows of flappers of same length. Pleurobrachia.

II. Body with large lateral lobes. Rows of flappers unequal in length. Mnemiopsis.

A. Nuda.

Beroë (Müller). Body ovate, hat-shaped, with pinkish color. No tentacles, no body lobes. Large central body

cavity. Chymiferous tubes anastomosing, with many lateral branches.

B. roseola.

B. II.

Pleurobrachia. Body spherical, transparent, colorless, of relative hard consistency. Meridional rows of flappers of equal length extending direct from the sense to the oral pole. Tentacles very long with lateral branches of crimson color, capable of being retracted into a chamber on each side of body.

P. rhododactyla.

Mnemiopsis.[1] Body transparent, compressed laterally and with two prominent lobes. Body colorless, with walls flexible. Tentacles short. Rows of locomotor flappers of unequal length. Four ear-like, ciliate (?) appendages ("auricles") near the mouth.

M. Leidyi.

Free-swimming larvæ.

The larvæ of the Ctenophora are among the most common of all the medusæ found in surface-fishing. The eggs sometimes occur in great numbers in the collecting jars where any of the different genera have been allowed to remain for a short time. They are sometimes found single, sometimes in strings. Ova are small when single as in Mnemiopsis and others, but can be observed with the unaided eye. These little transparent globes enclose an egg, the growth of which can easily be followed through early stages of segmentation. The larvæ of the Ctenophora, after leaving the egg sac, are difficult to refer to

[1] *Bolina alata* is closely allied to this genus.

their respective genera. Those of Beroë never have tentacles. Of the tentaculated genera Pleurobrachia and Mnemiopsis, the former has long tentacles which never diminish in size with age and is destitute of lateral lobes, while the latter has widespreading lobes which increase very greatly in size with advancing growth and the tentacles become smaller and smaller in the progressive growth. The adult has rudimentary tentacles. The young of the Ctenophora are never sessile, with no intermediate asexual form; consequently the development is said to be direct.

Class II. Actinozoa.

Cœlenterates attached or free. Stomach bag-like, with linear mouth opening into body cavity. Radial septa in body cavity. Internal sexual bodies. Without medusiform gonophores, solitary or colonial. Body soft with mural spicules, calcareous septa horny, flinty axis. Often shrub-like, branching.

Actinoida.

Tentacles twelve or numerous, hollow, sometimes perforate, rarely branched. Bodies soft. Skeleton when present calcareous. Spicules absent in body.

A. Bodies soft, generally solitary, attached or free. Tentacles numerous . . . . Actiniaria.

I. Adherent.

Disk lobed . . Actinoloba (Metridium).

Disk not lobed. Body covered with warts. Bunodes.

Cœnosarc developed. Colonial, two circles of tentacles . . Polythoa (Zoanthus).

Tentacles, many circles. Solitary. Tealia (Rhodactinia, Urticina).

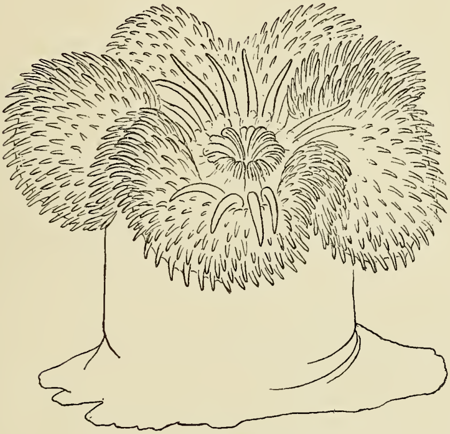
II. Communal and adherent.

a. In branching colonies . . Lophohelia.

b. In calcareous encrustations . Astrangia.

III. Not adherent.

Lives in sand, not colonial.



ACTINOLOBA (METRIDIUM).

a. Tentacles simple, slightly retractile. Ilyanthus.

b. Tentacles in two sets, posterior opening. Cereanthus.

Body covered in sand, colonial. Individuals not connected with cœnosarc . Edwardsia.

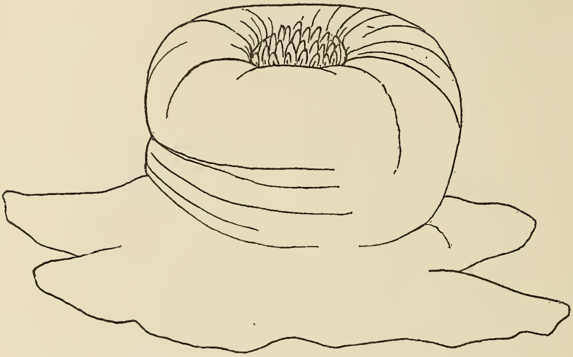
Parasitic in Cyanea . . . . Philomedusa.

A. I.

Actinoloba. Body fixed. Outer surface smooth. Tentacles small, on lobes, retractile. Reproduction; fission,

gemmation and ova. Hermaphrodite. Eggs develop internally. Abundant everywhere at low tide.

A. marginata.



ACTINOLOBA WITH BODY CONTRACTED.

Bunodes. Body with thick walls, covered externally with warts. Tentacles short, not numerous, in four rows.

B. spectabilis.

Polythoa. Polyps in clusters connected by living cœnosarc. Attached to shells inhabited by hermit crabs, worms, etc. *P. parasitica.*

Tealia.[1] Solitary, tentacles in many series. Base large. Body bright red, smooth; when retracted, flat.

T. crassicornis.

nodosa. (?)

A. II.

Lophohelia. Colonial, branched. Polyps irregularly alternate, widely separate. Calycles cup-shaped, slightly protuberant. Axis solid, zigzag. Deep water.

L. prolifera.

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[1] Urticina.

Astrangia. Skeleton calcareous encrustations. Not branching. Individuals closely crowded. Corallum circular, sometimes polygonal by crowding. Septa of equal size, not prominent, peripheral wall. Polyps cylindrical, tentacles numerous, dotted with clusters of nematocysts. Terminal clubs. Tentacles retractile. Ova vomited through mouth when laid. South of Cape Cod.

A. Danæ.

A. III.

Ilyanthus. Body free, tapering posteriorly. Tentacles slightly retractile. No posterior orifice.

I. lævis.

Cereanthus. Body elongated, vermiform. Two series of tentacles which alternate with each other. Posterior part present.

C. borealis.

Edwardsia. Colonial, not attached by cœnosarc. Posterior extremity inflated, not perforate, membranous. Tentacles on a retractile column. Motion in retraction rapid. Color white. Young, Arachnactis.*

E. sipunculoides.
farinacea.
sulcata.
carnea.
lineata.

Philomedusa. Body vermiform with posterior sac. Posterior opening? Tentacles few, short, thick, conical.

P. parasitica.

Madreporaria.

Solitary or colonial. Secrete lime skeletons. Tentacles numerous, hollow; no external opening, retractile.

[1] The young of *E. lineata*? is said to be the Actinian parasite of Mnemiopsis.

I. Solitary, not attached[1] . . . . Pennatulacea.
II. Attached.
 a. With axis . . . . Gorgonacea.
 b. Without horny axis . . . Alcyonacea.

Body with circular base with calcareous septa. No ring-shaped wall. Six peripheral tooth-like extensions of calcareous septa. Septa large and small, alternating in two or more series. Each septa with lateral ridges. Unattached. Lower surface ribbed. Deep water.

Deltocyathus.

Body horn-shaped, prolonged to a posterior projection. Two axes of different lengths. Peripheral wall. Large prominent septa which rise above the upper surface; no centrifugal peripheral teeth. One series of septa.

Flabellum Goodei.

Alcyonoida.

Compound corals with eight pectinate or branched tentacles. With or without sclerobase. When sclerobase is present, horny, calcareous or siliceous. With a cortical layer formed of consolidated or scattered spicules.

Pennatulacea. Free or with base buried in sand, pen-shaped, composed of an axis and leaf portion. With spicules. Sclerobase small flexible rod. Polyps on edge of leaf. Zoöids small on axis.

Gorgonacea. Rooted, plant-like, branching. With horny or siliceous sclerobase or loosely consolidated spicules in axis. Cortical layer present or absent in dry specimens.

Alcyonacea. Attached, fleshy, with scattered spicules. Massive, colonial. Without sclerobase.

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[1] Deep water; not strictly belonging in this paper.

Pennatulidæ.

Pennatula. Polyp region with prominent flat leaves which are two ranked, opposite. Polyps marginal. Shaft smooth. Color of leaves red, shaft at end white. Phosphorescent. Aperture of polyps with spinose spicules.

P. aculeata.

Balticina. Polyps in oblique rows, two in each row. Leaves not prominent. Calycles (polyps) spinose. Zooids on the axis between the leaves. Axis below the leaves smooth. With terminal polyp. Leaves pale-purple. Axis salmon color.

B. Finmarchica.

Virgulariadæ.

Virgularia. Stem filiform; polyp region linear with sessile curved lobes on upper end. Polyps marginal. Pinnæ wanting.

V. Ljungmanni.

GORGONACEA.

Alcyonacea.

A. Without sclerobase, the axis formed of consolidated spicules.

Alcyonium. Polyps prominent; solitary. Body lobed, with spicules. Prominent circumoral spicules. Pores star-like. Encrusting submerged bodies. White or red, axis generally white.

1. Large, markedly lobed . . . . *A. carneum.*
2. Small, nodose, bright-red . . . *A. rubiforme.*

Paragorgiidæ.

B. With horny or siliceous sclerobase and generally with cortical layer.

1. Sclerobase with nodes and internodes.

Paragorgia.
Anthothela.
Acanella.

2. Sclerobase horny.

Acanthogorgia.
Paramuricea.
Primnoa.

B. 1.

Paragorgia. Coral large, branching with axis formed of spicules. No horny deposit.

P. arborea.

Anthothela. Coral irregular with spiculose axis of fusiform spicules. Calycles prominent, not retractile. Cœnosarc thin. Spicules warty in cœnosarc and calycles.

A. insignis.

Acanella. Branched with nodes larger than internodes. Nodes very hard. Cœnosarc thin. Tentacles stiff with spicules.

A. Normani.

B. 2.

Acanthogorgia. Coral slender, flexible, branched, bushy. Cœnosarc thin with small, curved, wart-like spicules which do not project. Calycles elongated. Disk surmounted by eight groups of long, divergent, spine-like spicules. Body spicula, rarely projecting.

A. armata.

Paramuricea. Differs from Acanthogorgia in possessing shorter calycles and shorter marginal spines. Spicules irregular, flat, branched.

P. borealis.

Primnoa. Central axis horny, branched; cortical layer hard, with difficulty separated from the sclerobase. Calycles protuberant, with scales. Calicular apertures (mouths) with eight scales. Cortical layer rough on external surface.
P. reseda.

IV. ECHINODERMATA.

The animals which are included in the Echinodermata are all marine and are distinguished by a spinous integumentary covering. The integument may be filled with calcareous deposit in the form of sharp, pointed, immovable warts, or plates closely joined together, bearing sculptured and fluted movable spines. In some cases the integument is smooth and has embedded anchor-shaped calcareous spicules. The existence of spines has given the name of the Echinodermata, "hedge-hog skinned," to the group.

The form of the body varies very considerably. It has sometimes the form of an oblate sphere with immovable calcareous plates, as in the sea-urchins. In others the body is soft and vermiform. The majority are star-shaped, in which a central body and peripheral rays can be differentiated. In the ordinary star-fishes the body and rays are with difficulty distinguished. In the group of brittle-stars the body is sharply marked off from the rays which extend as long, highly flexible, worm-like bodies. These rays may be filamentous, as in the feather-stars, or divided and subdivided as in the basket-fishes. In the common star-fish we have ordinarily but five rays, while in the sun-stars the rays are numerous. In the pentagonal star-fishes the interval between the rays is filled up, the tip only extending beyond the five angles, and the distinction between the central body and peripheral arms is almost lost.

The star-shape disappears wholly in the sea-urchins

which have a spherical body with no arms. The body is ordinarily spinous, whence the name of the typical genus, Echinus. In Echinarachnius, the "sand dollar" or "sand cake," the sphere is flattened into a thin, slightly conical disk.

In most of the Holothurians, "sea-cucumbers," the body is columnar; in some vermiform. In this group portions of the body may be covered with scales without prominent spines, but is leathery, or soft and flexible.

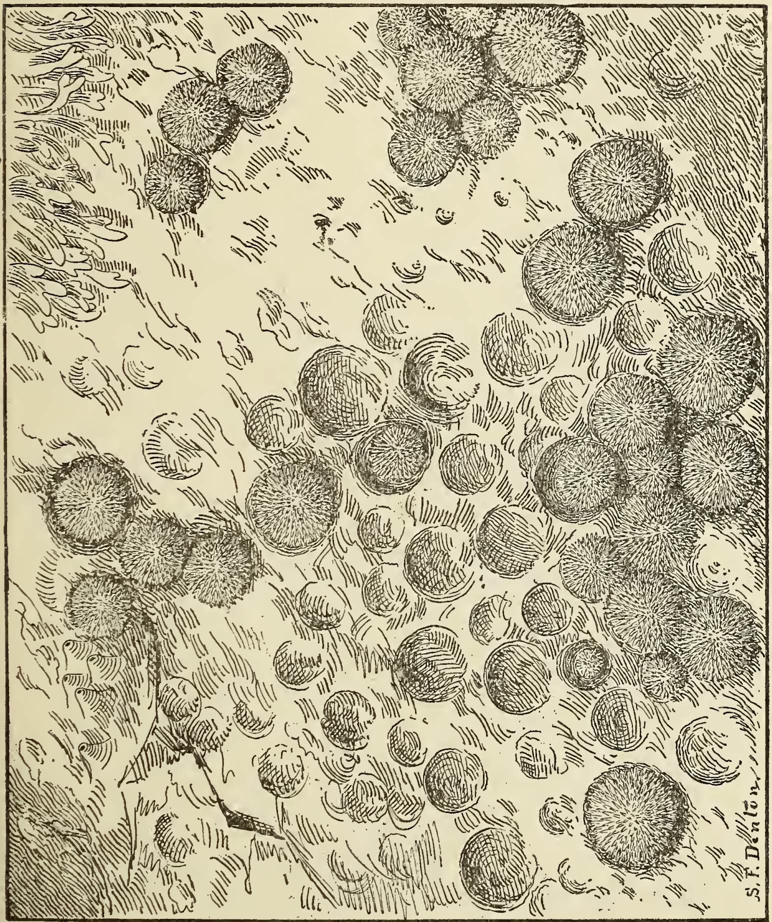
The stellate Echinoderms are distinguished by an oral and an aboral region. The oral region in the star-fishes is situated below; in the Crinoids above, as the animal is ordinarily placed. A mouth is found at or near the centre of the oral region. The vent when present is, in the star-fishes, on the centre of the aboral region. The brittle-stars have no vent.

The oral surface of the star-fishes is formed of five double rows of plates extending from mouth to extremity of the ray. These plates are called ambulacral plates and from the intervals between them arise the feet which are often with suckers at the free end and with a single or paired inflation or ampulla at the opposite end in the body. These feet are in two or four rows in each ray. In the brittle-stars the ambulacral plates are covered by a ventral series of plates or integument.

In the spheroidal Echinoderms the aboral surface of the star-fish is reduced to a small circle at the pole opposite the mouth. The ambulacrals appear as meridional rows of plates extending from mouth to aboral circle. In the "sand dollars" a portion of these plates on the upper surface is specialized into a rosette of five pairs of plates arranged in a series known as the petaloid region. The position of the anus varies in the sea-urchins from the neighborhood of the mouth to a point on the opposite pole

of the body. Our common sea-urchin sometimes excavates cavities in the solid rock.

In the "sea-cucumbers" the structure of the ambula-



SEA-URCHINS IN EXCAVATIONS.

cral plates is obscure. In some genera a foot is formed by the modification of three of these series; in Cucumaria we find five double rows, and in Thyone the suckers are ir-

regularly distributed. Certain sea-cucumbers and brittle-stars have feet destitute of suckers.

The nervous system is exposed to the water in star-fishes, but is covered by a series of plates in brittle-stars and sea-urchins and is internal in sea-cucumbers. Eye-spots are found at the ends of the rays in star-fishes; in a ring about the aboral region in sea-urchins and are wanting in Crinoids and brittle-stars and possibly in sea-cucumbers. Special organs of smell exist on the under or oral surface of the star-fishes as shown by physiological studies. Otocysts are known in deep-sea genera.

The ovarian openings lie in the angles of the rays or in the vicinity of the mouth in star-fishes; in a circle about the aboral region in sea-urchins and on the lateral cirri in Antedon. In brittle-stars there are four broad openings on the side of the disk, called by some genital slits. By many naturalists these are regarded as respiratory openings. Holothurians generally have a single sexual opening near the mouth.

A madreporic body or convoluted prominence is well marked in star-fishes and sea-urchins and hidden or wanting in snake-stars and sea-cucumbers.

The sexes are ordinarily separate. Some star-fishes, snake-stars and the sea-cucumbers are probably hermaphrodite. The Echinodermata have a direct or indirect development, and some are viviparous.

The Echinodermata of our coast are divided as follows:

Free Crinoidea.

Body with pinnate rays, with jointed cirri on the aboral region.

Asteroidea.

Body stellate or pentagonal, with an aboral and oral region, the latter only crossed by five or ten double radial

rows of protrusible legs. No line of demarcation between body and arms.

Ophiuroidea.

Body stellate with a central disk and peripheral arms sharply marked off from each other.

Echinoidea.

No peripheral arms, body spherical or discoidal, spiniferous, inflexible.

Holothurioidea.

No peripheral arms, body columnar, flexible, tegumentary, partially squamous or leathery. Not spiniferous.

Asteroidea.

Body stellate, with no separation between disk and arms. Abactinal region large, flexible, with embedded calcareous deposits. Spines on the abactinal region small. With suckers and ampullæ arranged in two or four rows in each arm. Ambulacral plates not covered. Nervous system and water system of the arms naked. Eye-spots at extremity of the arms. Ovarian openings in the angle of the arms. Madreporic body conspicuous on aboral surface. Stomach and hepatic cœca in both arms and disk. Polian and racemose vesicles. Young a free brachiolarian, or viviparous. Pedicellariæ sessile, biparted.

A. Body stellate, five or six rays.

B. Body stellate, with numerous rays.

C. Body markedly pentagonal.

Asterias. Body star-shaped with normally five arms (six? in one species). Rays with marginal spines and plates, and with four rows of ambulacral plates. Arms long, inflated.

a. Five rays (in normal specimens).

I. Color reddish, madreporic body dull in color. Free larvæ take the form of brachiolaria.

A. vulgaris.

II. Color brownish, madreporic body bright red or more often orange.

A. Forbesii.

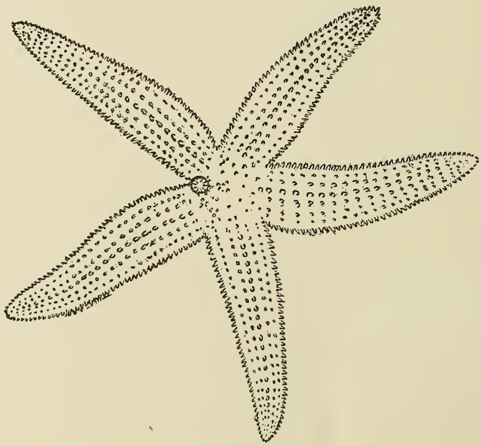
b. Six rays.

Spines scattered, large, slight constriction between arms and disk.

A. polaris.

Leptasterias. Body stellate, five-rayed with prominent scattered spines; color white or light gray. Young viviparous, attached by a cord on the oral region.

L. tenera.

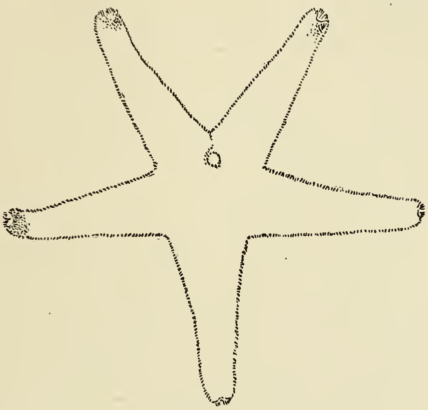


ASTERIAS.

Cribrella. Body smooth, stellate, five rayed, covered with short spines and spine warts, porous integument. Lateral spines small and inconspicuous. Two rows of

sucker-feet. Bright colored. Young bright red. Development direct. Young carried about the mouth.

C. sanguineolenta.



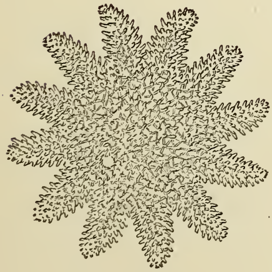
CRIBRELLA.

Solaster. Body smooth with short spines. Lateral spines small or inconspicuous. Radius of disk large as compared with that of the star-fish. Color red.

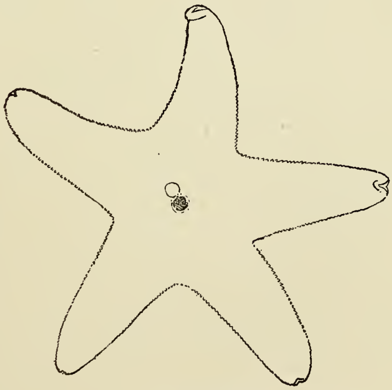
S. endeca.

Crossaster. Body and abactinal region of the rays studded with tufts of spines. Color red.

C. papposa.



CROSSASTER.



PTERASTER.

Ctenodiscus. Aboral surface paved with short, thickly set spines. Madreporic body large. Central protuberance in centre of aboral surface. Edges of rays paved with rectangular plates which bear spines. Rays terminated by a single median rounded plate.

C. crispatus.

Asterina. Body pentagonal, thick, flat with thin margin, destitute of rectangular plates. Small.

A. borealis.

Pteraster. Body with aboral region covered by a thin tent-formed integument stretched over the body poised upon the tips of clusters of aboral spines to which it is joined. Tent-like membrane flexible. There is a central opening in tent-like membrane. Madreporic body hidden and seen by cutting off the covering. Young carried in the groove-formed marsupia extending from the sexual openings to the central orifice. *P. militaris.*

Hippasterias. Body with short, stumpy spines. Bright red color; obscurely pentagonal. Aboral plates of uniform size. *H. phrygiana.*

Ophiuroidea.

Stellate echinoderms with central disk and long, flexible, simple or branched arms. Body markedly separate from the arms. Ventral surface of the arms covered with plates or integument. Stomach and ovaries confined to the disk. No ambulacral suckers; locomotion by spines, hooks and motion of the arms. Viviparous, or young have the form of pluteus.

Rays simple, not branched, ventral plates present.

Ophiuridæ.

Rays branched, ventral plates replaced by a leathery skin. Arms capable of infolding about the mouth.

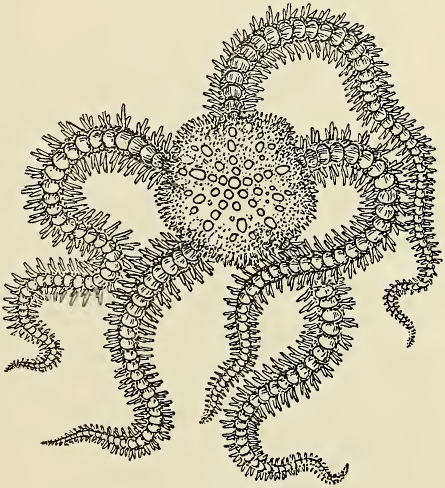
Astrophytidæ.

Ophiuridæ.

Disk circular and tegumentose above, with or without radial plates. No anus. Madreporic body small, or wanting. Arms simple, with aboral, lateral and ventral plates. Ambulacral plates hidden under the ventral. Blood system and nerves covered by ventral plates; feet in single row at edge of the ventral plates, without suckers or ampullæ. Motion by jerks. Hermaphrodite or bisexual. Young has a free pluteus, or adult viviparous. Genital slits large.

Ophiopholis. Disk with small spines. Teeth. No teeth papillæ. Arm-spines flat, stout, arranged on the side plates. Color generally brownish-red. Primary plates in brachial and interbrachial regions. Young, pluteus.

O. aculeata.



OPHIOPHOLIS.

Ophioglypha. Disk with crowded, naked, distorted scales. Radial shields swollen. Arm-spines few (three). Tentacle scales numerous. Color gray with light bands on the arms, also yellowish. Probably viviparous.

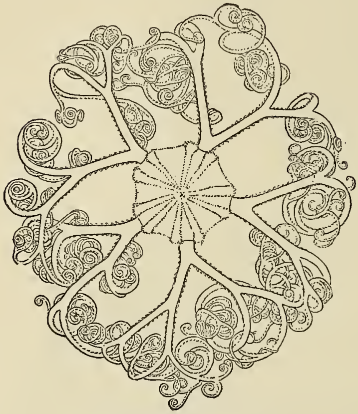
O. Sarsii.

Amphiura. Disk small, delicate, with naked overhanging scales. Arms slender. Arm-spines short. Arms four and one-half times the diameter of body. Color brown. Viviparous. *A. squamata.*

Astrophytidæ.

Disk and arms with thick scaleless skin. Radial shields extend to centre of disk, forming elevated radial ribs. Arms branched many times. No arm-spines except at tip of branchlets, where there are microscopic hooklets. Arms folded ventrally. Radial ribs yellow; interbrachial region brown or red. Radial ribs with short conical spines. Interbrachial region of disk smooth or with short spines. Ventral plates replaced by integument.

Gorgonoce halus Agassizii.



GORGONOCEPHALUS.

Echinoidea.

Body cylindrical, disk-shaped, without arms. Calcareous, inflexible, composed of immovable plates. Apical area with anus or destitute of same. Ovarian openings, eye-spots and madreporic body around the apical area. Locomotion by suckers and spines. Five double rows of ambulacral and five rows of inter-ambulacral plates. The teeth are highly specialized into an apparatus called the Aristotle's lantern. Pedicellariæ pedunculated, trifid.

I. Echinoids. Body spherical with ambulacral zones equal in length, unmodified from apical to oral region. Aristotle's lantern. Development with pluteus. Ovaries five.

II. Clypeastroids. Body flat, disk-shaped; ambulacral openings on the aboral surface, modified into five pairs

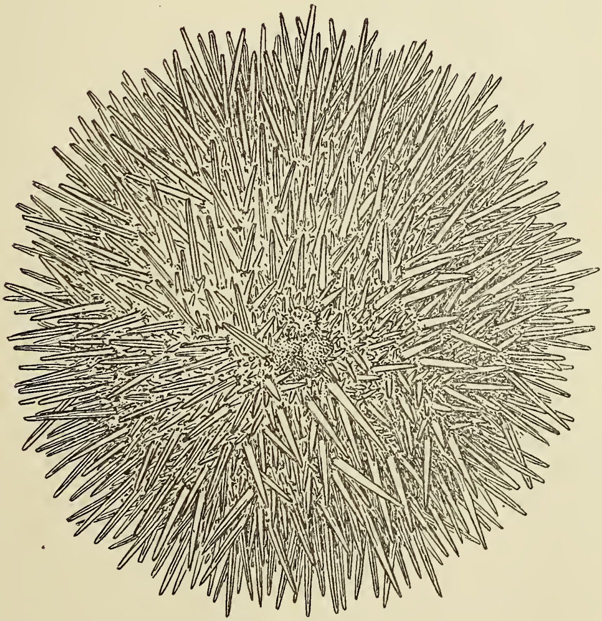
of petaloid openings. Anus on edge of disk. Aristotle's lantern. Development with pluteus. Ovaries five.

III. Spatangoids. Body swollen, globular, elongated. Ambulacral zones of different lengths, and more or less modified mouth and vent asymmetrical. No Aristotle's lantern. Development with pluteus. Ovaries four.

Echinoids.

Arbacia. Body globose; vent and mouth opposite; two kinds of spines, the larger few in number; color purple. Anus closed by four triangular plates. Pluteus with two lateral anal rods.

A. punctulata, Lam.



STRONGYLOCENTROTUS.

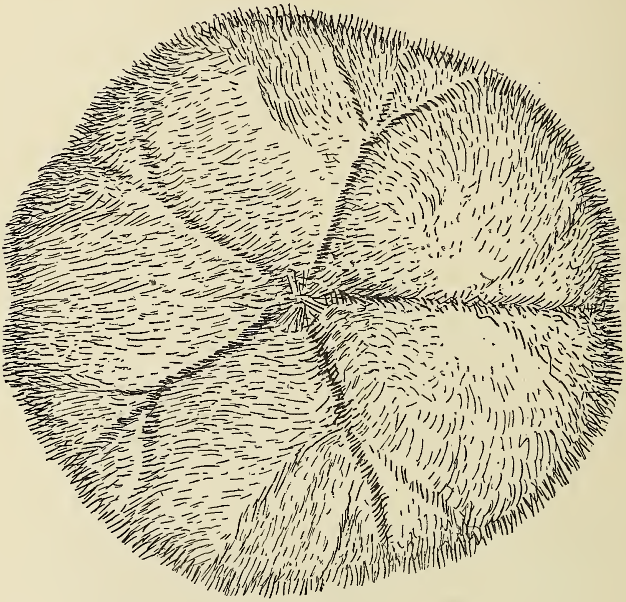
Strongylocentrotus. Body globose; anus and mouth opposite. Spines of one kind, short, small, greenish color.

Apical area with irregular plates. Pluteus without anal rods.

S. Dröbachiensis.

Clypeastroids.

Echinarachnius. Body nearly circular, very flat with sharp, entire margin. Vent close to edge. Petaloid re-



ECHINARACHNIUS.

gion marked. Spines small, short, brown or reddish color. Pluteus without anal rods.

E. parma.

Spatangoids.

Schizaster. Body heart-shaped, irregular, oval with avenues on the upper surface. Mouth asymmetrical. Test thin, fragile. Ambulacral zones depressed and petaloid. Pluteus with single median calcareous rod on the anal lobe.

S. fragilis.

Holothurioidea.

Body elongate, vermiform with oral and anal openings at opposite poles of the animal. Skin leathery often covered with scales, sometimes spinous, often with embedded spicules or anchors. Ambulacral suckers wanting or present. When the latter are present, in three to five rows.

With suckers . . . . Pedata.
Without suckers . . . . Apoda.

Pedata.

Cucumaria. Suckers in five regular rows, alternate in each row, closely oppressed. Tentacles ten. Dental apparatus.

C. frondosa.

Lophothuria. Suckers in three rows and on one side which forms a soft foot. Other ambulacral furrows rudimentary; absent. Body covered with scales. Tentacles ten.

L. Fabricii.

Thyone. Body with scattered wart-like suckers. Tentacles ten. Teeth filamentous.

T. scabra.
elongata.

Apoda.

Caudina. Body long, whitish without suckers, prolonged into a long appendage at one end (anal). No "respiratory tree."

C. arenata.

Leptosynapta. Body vermiform, long, transparent. No suckers. No jaws. Tentacles long, divided into finger-like branches. Respiratory tree.

L. Girardii.

Larvæ of Echinoderms.

The larvæ of New England Echinoderms are either carried by the mother or free-swimming. The development

is either direct (without metamorphosis) or indirect. The larvæ of the free-swimming kind are as follows:

A. With long flexible ciliated arms. Transparent. Brachiolaria.

B. With long inflexible ciliated arms. Each arm with calcareous axis . . . . Pluteus.

C. No arms, with rounded prominences, not ciliated, bright red, opaque . . . . False pupa.

D. No arms, barrel-shaped, girt by parallel bands of cilia . . . . Pupa.

E. No arms, with irregular lines or bands of cilia. No eye-spots.

1. Single convoluted band about mouth. Young Brachiolaria.
2. Double convoluted band non-continuous. Auricularia.

A. Brachiolaria.

The Brachiolaria is the young of the star-fish, Asterias. It has a bilateral arrangement of long flexible arms. Transparent, slightly pigmented arms. With large open mouth, œsophagus and intestine. Elongated water-tube on each side of stomach. Dorsal pore. Young star-fish appears on left water-tube at or near region of stomach.

B. Pluteus.

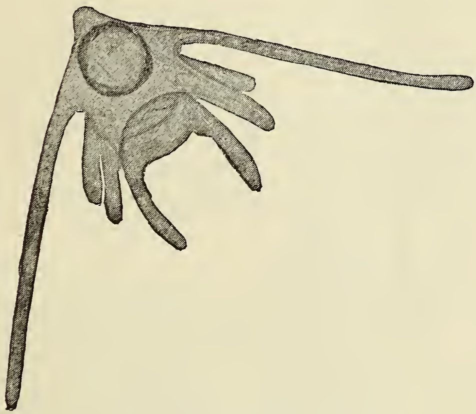
1. Pluteus with two arms, very long . Ophiopholis.
2. Pluteus with anal arms . . . . Arbacia.
3. Pluteus with epaulettes . . Strongylocentrotus.
4. Pluteus without epaulettes . . Echinarachnius.

The pluteus is the larval condition of the Ophiuroidea and Echinoidea. It is distinguished by the possession of calcareous axes in the arms.

1. The adult pluteus of Ophiopholis has two arms very much longer than the others.

2. The pluteus of Arbacia has eight oral and two anal arms. No other New England pluteus has the two anal arms as far as known.

3. The pluteus of Strongylocentrotus has eight oral arms and epaulettes, ciliated appendages formed by the outgrowth of the ciliated chords at the angle of the junction of the arms (larger) with the body.



PLUTEUS OF OPHIOPHOLIS.

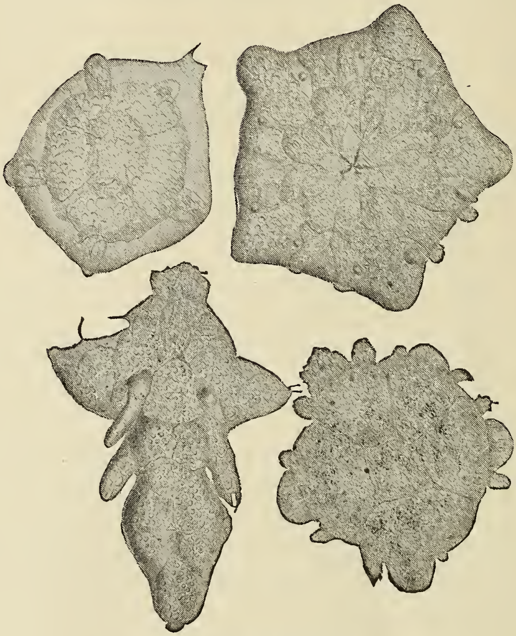
4. The pluteus of Echinarachnius is without epaulettes, with eight arms, six of which bear marked pigment spots near their extremities.

C. *False pupa.*

The false pupa is probably a young of Lophothuria. It is globular, bright red in color, opaque, with a cluster of knobs at one pole and two knobs on one side. The former develop into the tentacles of the adult, the latter into feet of the soft foot-like region of the body.

D. Pupa.

A pupa has been found at Newport which is referred to Leptosynapta. Body, barrel-shaped, girt by rows of cilia in bands. Mouth at one extremity and tentacles seen through the body walls. Calcareous deposits in the walls under the ciliated bands. The young of this pupa is an Auricularia.



YOUNG OF AMPHIURA.

Attached young.

The young of the following New England genera of Echinoderms are attached, borne on the mother or have an indirect development.

OPHIURANS.

Amphiura squamata.

This species is hermaphrodite and the young reach a stellate form before they leave the parent. Provisional spines corresponding to the plutean spines are developed, to be later lost.

Ophioglypha Sarsii.

Said to be viviparous?

ASTEROIDS.

Larva with club-shaped, opaque larval body carried about the mouth. Color, white or brownish.

Leptasterias.

Larva without club-shaped body. Color, bright red, carried in a pouch made by an infolding of the mouth.

Cribrella.

Larva carried in pouches between a tent-like covering on the back and the back (aboral) region of the adult.

Pteraster.

No Echinoid found in New England is known to have a direct development.

Asterina.

GENERAL DIRECTIONS.

As will be noticed, the preceding pages are almost wholly devoted to means and methods of collecting, and identifying unknown Cœlenterata and Echinodermata when they are found. It likewise seems appropriate in an article of this nature to aid the collector by approaching the subject from a somewhat different side. Where shall one go, and how collect certain of these animals the systematic position and name of which are known? Information as to the locality where any desirable genus of these groups can be found without failure, and hints as to special methods to be followed in procuring it may also with advantage form a part of this work. Teachers desiring for instance a supply of star-fishes or sea-urchins for class instruction might regard it a help if some information be imparted in this direction. Hints as to how to procure certain typical larval forms may also not be out of place here.

I have therefore chosen a few available types from each group, and endeavored to offer suggestions as to modes of collecting and places to be visited, which rarely fail to reward the collector.

Some of the Cœlenterata and Echinodermata are gregarious; others live apart more or less isolated. The time and place of the appearance of nomadic animals are not constant, and no rule can be laid down which will be sure to guide one in the collecting of such genera. Moreover, the home of many may vary in different months, and even

some of the sedentary genera may retire to deep water in certain seasons. Except that one might mention a locality where he had collected them, it is next to impossible to direct a collector to a place where the large majority can always be found without failure.

Among the Hydrozoa the problem of habitat is perhaps more difficult to solve than among the other groups. Most of the free genera are so sporadic in their appearance that it is difficult to say where one should go on any fixed date, and not be prepared for failure. The places where these have been taken are so widely spread along our coast that they may be said to occur anywhere along the shore, but for the great majority of nomadic genera there is great uncertainty that at any definite time they can be found in numbers at any one of these places. With the fixed hydroids it is however different, on account of the nature of their habitat.

The several genera of fixed hydroids prefer as a general thing a rocky bottom just below low-tide mark. Their favorite habitats are rocky cliffs exposed to the sea, or quiet pools left by the retreating tide. They are also fond of the fronds of Laminaria and Fucus, buoys and submerged parts of wharves and landing stages. The bottoms of boats which have been continuously in the water for some time are often covered with these animals. Although the majority are to be found in these and similar places there are a few which are attached to the sand or live in the mud.

Clava leptostyla, which may be taken as an available type of the so-called Tubularian hydroids can always be found at low tide on the small ledge of rocks near Beverly Bridge. This locality I have repeatedly visited for the purpose of collecting Clava, and have never been disappointed in obtaining a large number. It is found attached to the Fucus which hangs from these rocks into the water.

Tubularia indivisa can always be found at low tide clinging in clumps to the piles of Beverly Bridge, just below low-water mark. With it are associated great numbers of Campanulariæ and Obelias.

If one wishes the common Sertularia (*S. pumila*), one of the best collecting places for this most common hydroid is Revere Beach at low tide. Almost every fragment of Laminaria or "oarweed" washed up after a storm will be found to be peopled with this delicate species. It is moreover common at all times of the year.

The shells of Lunatia inhabited by the so-called hermit crab are favorite habitats for *Hydractinia echinata*, but it is also found encrusting submarine objects, floating logs, water-soaked ropes, and the under surface of buoys.

I am not acquainted with a single locality which will always reward the collector with numerous specimens of the different genera of Ctenophora and Siphonophora, although it is safe to say that a few weeks at Eastport with constant examination of the water about the wharves will probably reveal a limited number of specimens of Beroë and Bolina, and possibly an unexpected multitude of *Nanomia cara*.

I have found the ebb tide at the "draw" at Beverly Bridge to sometimes bring down many large examples of the acraspidote medusa, *Aurelia flavidula*, but as with all floating jelly-fishes no locality can be mentioned where it can be found without failure in quantities. *Cyanea arctica* may sometimes be seen by the score about the Boston docks and near the bridges, yet many visits to these places might be made without seeing a single specimen. Dactylometra and Callinema are rare Acraspeda.

Our most common Actinian, *A. marginata*, can always be collected in abundance on the piles of Beverly Bridge. This is one of the most easily obtained of all of our ma-

rine animals, and can be had in quantity in every month of the year. As it is very hardy it can readily be transported alive, and kept in good condition for some time in the class room.

Alcyonoids are as a rule not gregarious and must be obtained by dredging. I can recommend for some of the genera of this group the broken shelly and clay bottom half-way between Eastport and Campobello. One or two of the genera attach themselves by preference to the interior of broken Mytilus shells, but they are rarely found in multitudes, although at a single haul of the dredge at the place mentioned I have often taken more than a dozen.

Echinoderms are found on rocky or clay bottoms, in sand, among broken shells and in the coralline zone, from moderate depths to the line of low tide. Among the Ophiuroidea, *Ophiopholis aculeata* can always be found just below low tide at Nahant. It is a habit of this and some other genera of snake-stars to avoid the light, so that one must search for them under stones and in the crannies and crevices of rocks or similar secluded places. If a large number of Ophiopholis is desired, a visit to Clarke's ledge, Eastport, will reward the collector with as many as he can well take care of.

The best grounds for collecting *Gorgonocephalus Agassizii* are the Race off Race Point, Provincetown, and the Channel at Eastport off the Old Friar, Campobello, but this genus can never be found in shore collecting. The genus is gregarious.

Asterias, the common star-fish, is found in abundance in many localities. A visit to Beverly Bridge, Revere Beach or Nahant, is sure to reward the collector with at least a few. If one wishes a larger number, Eastport, or best of all Grand Manan will be more profitable. Cribrella, like most of the other star-fishes, prefers a rocky bottom, but

occurs at times on a sandy shore. Crossaster is a rare star-fish and no assurance can be given as to the certainty of finding it in numbers in any single locality. Razor Island, Eastport, almost always contributes a few specimens of Pteraster and Ctenodiscus to the dredge. The latter genus can be dredged in abundance off Treat's Island, Salem.

Decaying meat or fish is a good decoy for many Echinoderms, especially star-fishes and sea-urchins, and when a box is baited with this and left over a tide under water these scavengers are generally found collected in it.

The Echinoids make their homes on both rocky and sandy bottoms. If one wishes a large number of Strongylocentroti he will find them almost anywhere along the Maine and Massachusetts coast where there is a rocky shore. At low tide at Grand Manan one can gather them by hundreds and the sea bottom of the littoral zone is there paved with these animals at certain points. The largest area which I have ever seen covered with these animals is near Mr. Cheeney's house at the Point, Nantucket Island, Grand Manan, but it is also very common at Eastport and farther south.

Echinarachnius parma prefers sand as a dwelling place. It can be dredged in great numbers off Revere Beach, in Provincetown Harbor and off Ipswich Beach. The channel which separates Nantucket from the main island of the Grand Manan group is a very profitable dredging ground for these animals. The Cove at Eastport and the adjoining beach afford a sheltered habitat for this genus.

The Holothurioidea live on gravelly, clayey or rocky bottoms, and some genera prefer to burrow in the sand.

Pentacta frondosa lives in numbers in the Eastport waters and can be dredged a half mile from the wharf. Indian Island is a profitable place to visit for this species

for in the waters near by it is more common than elsewhere. The days following a violent storm almost certainly find Revere Beach strewn with multitudes of *Caudina arenata*. Leptosynapta is abundant in the littoral zone in front of the large hotel at the Point of Pines, but it must be dug out of the sand for it lives buried in the beach. I have never discovered a good locality where more than a few specimens of Cucumaria can be found on a single collecting trip.

A few special hints in regard to collecting ova and younger larval stages may have some value.

A means of obtaining the free Medusæ of the Hydroida is to keep the attached hydroid in an aquarium until the zoöids are dropped. In that way, if successful, a large number of individuals may be obtained, but the collector must be prepared to meet with many failures, for most of the hydroids are not hardy, and the laws[1] which determine the time when individual hydroids mature their zoöids are not easily formulated. Obelia, Campanularia, Syncoryne, and Clytia are good genera to use in endeavors to raise the zoöids.

Artificial fecundation may in some cases be resorted to for an abundant supply of the young of several of the New England Cœlenterata and Echinodermata. While it will probably be found that a majority of the genera composing these groups can be successfully reared in this way, up to the present time only a few have been experimented upon with satisfactory results.

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[1]Various circumstances probably retard or accelerate the rate of growth of the young of the Cœlenterata and Echinodermata. One of the most important is, possibly, difference of temperature. As the temperature rises Ophiopholis eggs mature more rapidly, and pass through their segmentation and larval conditions more quickly, and the same may also be the case with many other genera. Various other conditions, as amount of food, also have an important influence on the time of ovulation and the rate of growth of larvæ, so that until these facts are better known it is not possible to understand completely the laws governing periodicity of ovulation and growth.

Possibly the best success in this line has been with the Echinoderms. *Echinarachnius* is a good genus from which to obtain a series of larvæ by artificial fertilization. The sexes are distinct, male and female sexual glands being found in different individuals. While it is not always possible to determine the sex by external coloration, an examination of the interior just under the middle of the upper side will easily betray it. To artificially fertilize Echinarachnius the observer may first make a ring-shaped incision through the aboral calcareous wall allowing the animal meanwhile to remain in the water. Carefully remove the incised portion, and suck up in a pipette a few fragments of the dark red organs which lie just about the apex. Place these in a watch crystal filled with pure water, and if the fragments thus transferred contain ova they will soon give up little transparent globules dotted with bright red spots. The ovaries are dark red, and the spermaries white or yellow.

When a larger quantity of ova is desired, place the female Echinarachnius in a small dish, glass preferred, and with gentle streams of water from the pipette wash out the small globular eggs with care, and then remove the Echinarachnius and larger fragments of the ovary which may have been ruptured from the gland. Then suck up a small quantity of the white fluid from the male Echinarachnius into the pipette and place it in the watch crystal or dish with the ova. Stir the mixture gently and set aside for an hour and a half at which time, if the process has been a success, the ova will begin to segment. The young plutei can be easily reared from these eggs in great quantities, but care must be taken to change the water at least every two days. It is also well to pick out any fragments of sexual glands which may befoul the liquid.

A limited number of Amphiura young may be collected in August and September, possibly in other months, in the

following way. If a gravid specimen is kept in the aquaria a short time the young may crawl out through the genital slits and will then be found in the jar in which the adult is kept. If it is desirable to hasten the parturition the top of the disk of the parent may be removed and then the young washed out gently with a pipette from the sacs in which they are formed.

The young of Pteraster must be searched for in the grooves on the back covered by the tent-like membrane which is stretched from the tips of the spine; those of Leptasterias may be found attached near the mouth.

Asterias may be artificially fertilized and ova collected in numbers by a method similar to that described for Echinarachnius. Strongylocentrotus and Arbacia can also be treated with success by the same method.

It may happen in surface fishing that a large number of Cœlenterata and Echinoderm larvæ may be taken with the dip net in the method described under the use of that instrument. This method of collecting, however, does not yield the numbers, except in exceptionally good fishing that one can obtain by keeping the adults in confinement until the eggs are dropped or impregnated by artificial methods.

The collecting of young Cœlenterata and Echinodermata with the dip net to fill out a series has one among many advantages. From the fact that there is a slight variation in the time of ovulation, larval stages of marine animals in all conditions of growth may often be fished out of the sea in the same excursion. It thus happens that, for instance, in the case of the star-fish one may find the stages of growth from the youngest gastrula to the brachiolaria in the same collecting trip. By the method of collecting with a dip net it is thus possible to obtain more

hardy[1] specimens of older stages which sometimes through various causes have lost their vitality when raised in confinement.

The time of the year which is best suited for collecting depends closely upon the genera desired. For shore collecting and dredging, all the summer months are equally good depending on the state of the weather. Sedentary genera are not sensitive to the various conditions of winds, calms, tides, and other influences. With floating marine animals and the various larval forms of most sedentary genera the problem is somewhat different. Their appearance and abundance vary[2] from month to month and from year to year. It is difficult to say what month of the summer is best for collecting larval Cœlenterata and Echinodermata. The strong autumnal winds blow to the shore a large number of floating genera, but the number of quiet days in each month when these approach the surface of the water is limited. In midsummer months the weather is less boisterous and opportunities to capture animals are greater. My experience has taught me that August and September are more profitable for collecting floating genera than June and July. There is, of course, a connection

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[1]For some reason unknown to me some larvæ after having been raised through a number of early conditions invariably die, and new fishing has to be resorted to for more advanced stages. This is no doubt in most instances due to imperfect aeration of the water, neglect to provide proper food, or lack of proper care. The treatment of larvæ in confinement must vary more or less with the different genera.

[2]The periodicity in the time of the appearance is by no means constant. In some years great multitudes of certain medusæ appear day after day, and on a subsequent year not a single individual will appear. On my first visit to Grand Manan thousands of the beautiful Siphonophore, *Nanomia cara* were seen everywhere in the water so that they literally clogged my drag net. Suddenly, however, these all disappeared and in succeeding years in the same months I did not see a single individual. Every naturalist can probably mention similar equally remarkable instances of the sporadic appearance of some genus of marine life, and I am not familiar with any satisfactory explanation of the phenomenon.

with the time of ovulation for many genera cast their ova throughout the summer, although the ovulation of a majority is probably in the spring. Violent winds interfere with dredging and drive most of the floating life far below the surface. The early morning generally gives the smoothest water and at that time the sea often has a glassy calm which is most advantageons for the capture of many genera. Night collecting is claimed by many to yield the greatest number and variety of floating life.

The ever-increasing interest in the study of the marine surface fauna renders it timely that observations be recorded and tables be prepared containing the dates when pelagic larvæ of different genera can best be collected in some well-known locality. It would, to mention one of the advantages of a table collated from such observations, be of great help if anyone desirous of studying these animals could accurately know when the larvæ or adults with ova are most likely to be found, and could regulate his visit to the seashore by the information thus afforded. In some of the older marine zoological stations in Europe this has been done either in the form of card catalogues or published faunal lists with dates and places of capture.

It has been shown that there is a pronounced periodicity in the occurrence of these larvæ, and year after year an abundance of marine larvæ is looked for in certain months and at no other time.

It is not in the scope of this paper to consider why this is so, and if it were the author has many doubts whether anyone is familiar with enough data to suggest any satisfactory explanation for it. Continued observation for a number of years is necessary to arrive at any trustworthy conclusion, and it is desirable to gather statistics enough to justify general conclusions in regard to the probable time when larvæ can best be obtained for study. Most of the observations

on the time of the appearance of pelagic animals have been made in the summer months and very little is known of the genera characteristic of winter months. Our rigorous climate, however, does not invite collecting at that time and probably very little embryological work could be successfully carried on in the colder months. Of the life which I have collected in midwinter by surface fishing, larvæ and young form a very small proportion of the whole.

Every collector has his own preference for the best place to visit to collect marine animals, and it is not strange that it generally corresponds with the place which he has most often visited. I have worked at only a few stations in New England and am no doubt prejudiced in their favor. The wealth of floating life at Newport is the greatest known to me on the New England coast, but in the few excursions I have made at Wood's Holl, it has seemed to me that there was little difference in the amount of floating life in the two places.

For dredging, however, neither of these places can compare with Eastport and Grand Manan. The latter place is a paradise for the collector of Cœlenterata and Echinodermata. Several circumstances combine to make it such. The enormous tides which sweep around the islands lay bare a littoral zone of great breadth. They also, since their volume is so great, bring a large number of floating animals from deep water. "The opportunities for work at Grand Manan with the dip-net in the study of free-swimming animals are very great. The student of these forms of life is particularly recommended to visit the so-called "ripplings" or tide eddies, several miles from the shore, near the line where the platform of the islands sinks to the deeper sounding of the Bay of Fundy. These eddies are favorite feeding places of many marine animals,

from the whale to the minute Medusæ and Crustacea, and at a proper time of the tide afford most profitable collecting places." The distance from the shore and the difficulty of access are the only drawbacks, but if possible they should be visited by every collector who is interested in the collecting of marine life in its natural habitat. A world for investigation here awaits the attention of the naturalist.

An advantage in working at Grand Manan is the ease with which delicate marine animals can be kept alive in small aquaria for a considerable time. The water is very cold and the change in temperature not as sudden as in more southern parts of New England. My experience has been that the difficulty in keeping the water in small glass vessels used for aquaria at an even temperature with that of the bay is not as great in northern New England stations as in southern and the consequent danger of mortality is lessened. The constant fogs, however, are drawbacks which limit the number of days when collecting can be prosecuted. The small island of Nantucket[1] of the Grand Manan group is most favorably situated for a laboratory or for a point from which to reach the different collecting grounds.

The reader is reminded that there is no one locality on our coast where all the genera here recorded can be collected. Marine animals have their homes which are limited by as sharply drawn lines as those of any forms of organic life. Continued research on the facies of the New England marine fauna indicates the existence of conditions on the coast which separate the northern from

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[1] Grand Manan had on my visits a tri-weekly communication with Eastport by a small steamer. Eastport can be reached from Boston by the steamers of the International line, also called the St. John's steamers. There is a daily stage from North Head, the landing place of the steamer from Eastport to Grand Manan, to Woodward's Cove, which is near Nantucket island. Comfortable accommodations can be had at Mr. Cheney's home on the island.

the southern faunas by a line of demarcation of the most rigid character. The coast of Maine and Massachusetts bay is bathed by a cold Arctic ocean current which is replaced south of Cape Cod by warmer water. Although several genera straggle from one zone into the other, the majority are limited to their homes by this powerful climatic influence. Hence it is that one may expect to find a great difference in the marine life of Narragansett Bay and that of the Bay of Fundy, and while I have attempted to consider both in this article even the best of collecting places will not yield more than a small proportion of the genera considered. That part of my work which deals with floating life and with larval forms is necessarily very incomplete.

LIST OF CŒLENTERATA AND ECHINODERMATA FOUND IN NEW ENGLAND.

In the accompanying list I have mentioned the majority of the genera and species of Cœlenterates and Echinoderms which occur in New England waters. It is believed that this list includes the more common species of these animals which the teacher is liable to collect on his excursions. The identification of the majority of the animals of the list will, it is hoped, be facilitated by a knowledge of the generic and specific differentiation indicated by the diagnosis which is given of the more common types.

HYDROZOA.

Hydroidea.

Acaulis primarius Stimpson.
Aglaophenia arborea (Desor) Verrill.
Antennularia Kirsch.
Blastothela rosea Verrill.
Bougainvillea superciliaris Ag.

Note.—The figures of *Modeeria* (*Turritopsis*), *Zanclea* and *Cunina*, in the preceding pages were originally published in works by the author from drawings loaned him by Dr. A. Agassiz; that of *Acaulis* from drawings by Prof. A. Hyatt. To these naturalists and to all others to whom the writer is indebted, in the preparation of this Aid, the writer takes this occasion to express his appreciations of his obligation, and his sincere thanks.

Calycopsis typa Fewkes.
Calycella plicatilis Hincks.
" humilis Hincks.
" producta G. O. Sars.
" pygmæa Hincks.
" syringa Hincks.
Campanularia caliculata Hincks.
Campanularia flexuosa Hincks.
" *fragilis* Hincks.
" *neglecta* Hincks.
Campanulina acuminata Alder.
Cladocarpus cornutus Verrill.
" *spectabilis* Verrill.
" *Pourtalesii* Verrill.
Clytia bicophora Ag.
Clytia intermedia Ag.
" *cylindrica* Ag.
" *Johnstoni* Hincks.
Cladonema radiatum Dujardin.
Clavatella Hincks.
Clava leptostyla Ag.
Clavula vesicaria Verrill.
Corymorpha nutans Sars.
Coryne (Gaertner).
Cunina discoides Fewkes.
Cuspidella costata Hincks.
" humilis Hincks.
Dicoryne flexuosa G. O. Sars.
Diphasia fallax Ag.
" rosacea Ag.
" mirabilis Verrill.
Dinematella cavosa Fewkes.
Dipurena strangulata McCr.
Dysmorphosa fulgurans A. Ag.
Ectopleura ochracea A. Ag.
Eucheilota ventricularis McCr.
Eudendrium ramosum Ehr.
" dispar Ag.
" rameum Johnston.
" cingulatum Stimp.
" capillare Alder.
" tenue A. Ag.
Euphysa virgulata A. Ag.
Eutima gracilis Fewkes.
Filellum (see Reticularia) Hincks.
Gemmaria gemmosa McCr.
Grammaria abietina Sars.
Globiceps tiarella (McCr.) Ayres.
Gonothyrea hyalina Hincks.
" *Lovenii* Allman.
" *gracilis* Allman.
Gonothyrea tenuis Clark.
Halopsis cruciata A. Ag.
" *ocellata* A. Ag.
Hydrallmania falcata Hincks.
Hydractinia echinata Johnston.
Hybocodon prolifer Ag.
Halecium gracile Verrill.
Halecium articulosum Clark.
" *Beanii* Johnston.
" *muricatum* Johnston.
Hydrichthys mirus Fewkes.
Lafœa pocillum Hincks.
" *dumosa* Sars.
" *grandis* Hincks.
Lafœa robusta Verrill.
Lafœa fruticosa Sars.
Lafœa gracillima Sars.
Leptoscyphus Allman.
Liriope scutigera McCr.
Lizzia octopunctata Forbes.
Lovenella gracilis Clark.
Lytocarpia myriphyllum Kirch.
Mabella gracilis Fewkes.
Melicertum campanula Esch.
Modeeria (Turritopsis) multitentaculata Fewkes.
Myriothela phrygia Sars.
Nemopsis Bachei Ag.
Obelia gelatinosa McCr.
Obelia flabellata Hincks.
" *diaphana* Allman.
" *geniculata* Hincks.
" *polygena* (A. Ag.)
" *parasitica* (A. Ag.)
" *pyriformis* (A. Ag.)
" *fusiformis* (A. Ag.)
" *dichotoma* Hincks.
" *longissima* Hincks.
Oceania languida Ag.

Opercularella lacerata Hincks.
Ophiodes mirabilis Hincks.
Parypha crocea Ag.
Pennaria gibbosa Ag.
Perigonimus Sars.
Podocoryne carnea Sars.
Ptychogena lactea A. Ag.
Plumularia Verrillii Clark.
Reticularia serpens (*Filellum serpens*) Hincks.
Rhizogeton fusiformis Ag.
Sarsia mirabilis (see Syncoryne) Ag.
Salacia robusta Hincks.
Sertularia abietina Lin.
" *filicula* Lin.
Sertularia argentea Ellis & Sol.
S. argentea, var. *divaricata* Clark.
Sertularia latiuscula Stimp.
" *cupressina* Lin.
" *pumila* Lin.
Sertularella tricuspidata Hincks.
" *rugosa* Gray.
Sertularella polyzonias Gray.
S. polyzonias var. *gigantea* Hincks.
Sertularella Gayi Gray?
Stauridium Dujardin.
Staurophora laciniata Ag.
Stomobrachium tentaculatum Ag.
Syncoryne mirabilis Allm.
Syncoryne reticulatum (A. Ag.).
Stomatoca apicata Ag.
Thamnocnida spectabilis Ag.
" tenella Ag.
Thaumantias Eschscholtz.
Tiaropsis diademata Ag.
Tima Bairdii Ag.
Tubularia indivisa Lin.
Tubularia Couthouyi Ag.
" *stellifera* Couth.
Tubiclava cornucopiæ Norm.
Thuiaria articulata Flem.
Trachynema digitalis A. Ag.
Turris episcopalis Fewkes.
Willia ornata, McCr.
Zygodactyla Grœnlandica Ag.
Zanclea (see Grammaria) Gegenbaur.

SIPHONOPHORA.

Agalmoides elegans Fewkes.
Diphyes sp.
Diplophysa inermis Gegenbaur.
Eudoxia Lessonii Huxley.
Nanomia cara A. Ag.
Physalia arethusa Til.
Porpita sp.
Velella mutica Esch.

ACRASPEDA.[1]

Aurelia flavidula Per. et Les.
Callinema ornata Verrill.
Cyanea arctica Per. et Les.
Dactylometra quinquecirra A. Ag.

To these are allied the Lucernaridæ for which the reader is referred to H. J. Clark and E. Haeckel, System der Medusen.

Haliclystus auricula Clark.
Halinocyathus platypus Clark.
Lucernaria quadricornis Müll.
Manania auricula Clark.

CTENOPHORA.

Beroë roseola (Ag.).
Bolina alata Ag.
Lesueuria hypoptera A. Ag.
Mertensia ovum Mörch.
Mnemiopsis Leidyi A. Ag.
Pleurobrachia rhododactyla Ag.

[1]This group has been known by several names of which Discophora and Scyphomedusæ may be mentioned. At the present time the latter is thought by some naturalists to be the best name for the group.

ACTINOZOA.

ALCYONOIDA.

Acanella Normani Verr.
Acanthogorgia armata Verrill.
Alcyonium rubiforme Ehr.?
" carneum Ag.
Anthothela insignis Verrill.
Balticina Finmarchica Gray.
Cornulariella modesta Verrill.
Paragorgia arborea Edw. & Haim.
Paramuricea borealis Verrill.
Pennatula aculeata Dan.
Primnoa reseda Verrill.
Virgularia Ljungmanni Köll.

ACTINOIDA.

Actinoloba marginata Edw. & Haim.
Astrangia Danæ Agassiz.
Bolocera Tuediæ Gosse.
Caryophyllia borealis (Mosely).
Cereanthus borealis Verrill.
Deltocyathus Agassizii Pourtales.
Edwardsia sipunculoides Stimp.
" lineata Verrill.
Epizoanthus Goodei Verrill.
Flabellum angulare Mosely.
Ilyanthus lævis Verrill.
Lophohelia prolifera Edw. & Haim.
Philomedusa parasitica (Verr.)
Tealia nodosa (Fabr.).
" crassicornis.

ECHINODERMATA.

HOLOTHURIOIDEA.

Caudina arenata Stimp.
Chirodota læve Grube.
Cucumaria frondosa Jæg.
Leptosynapta Girardii Verrill.
Lophothuria Fabricii Verrill.
" squamata Verrill.
Molpadia oölitica Pourt.
Molpadia *turgida* Verrill.
Pentacta minuta (Fabr.). Verrill.
Pentacta calcigera Stimp.
Pentacta assimilis (Dub. & Kor) Verrill.
Psolus phantapus Oken.
" regalis Verrill.
Stereoderma unisemita Ayres.
Thyone scabra Verrill.
" elongata (Ayres) Verrill.
Thyonidium hyalinum (Forbes) Norm.
Thyonidium productum Stimp.

ECHINOIDEA.

Arbacia punctulata Lam.
Echinarachnius parma Gray.
Strongylocentrotus Dröbachiensis A. Ag.
Schizaster fragilis Dan. & Kor.

ASTEROIDEA.

Asterias vulgaris Stimp.
Asterias Forbesii Verrill.
Asterias stellionura Perrier.
Asterias polaris (Müll. & Tros.) Verrill.
Asterina borealis Verrill.

Cribrella sanguineolenta Lütk.
Ctenodiscus crispatus Dan. & Kor.
Crossaster papposus Müll. and Troschel.
Leptasterias tenera (Stimp.) Verrill.
Leptasterias compta (Stimp.) Verrill.
Hippasterias phrygiana Agassiz.
Pteraster militaris Müll. & Trosch.

OPHIUROIDEA.

Amphiura squamata Lyman.
Amphiura tenuispina Ljung.
Gorgonocephalus Agassizii Stimp.
Ophiacantha bidentata Ljung.
Ophioglypha Sarsii Lym.
Ophiopholis aculeata Gray.

NOTE.—The author has indicated by italics in the above list several genera and species which cannot be identified by the use of the "Aid." In addition to these there are several others which the author has never seen, and others which more properly belong to deep water than to the regions indicated for the scope of this article. For the introduction of these the author claims the kind indulgence of the reader. Many genera found in very deep water are omitted.

The author's studies of marine animals upon which he has mainly relied in the preparation of this "Aid" were made during his connection with Dr. A. Agassiz' Marine Laboratory at Newport, R. I., and the Museum of Comparative Zoology at Cambridge. He takes this opportunity to express his gratitude for the advantages afforded him at those places.

He has spent portions of four summers at Eastport and Grand Manan, and made frequent excursions to Provincetown, Beverly Bridge, Chelsea Beach and Ipswich.

A more complete list of the Actinoids and Echinodermata will be found in "Verrill's List," which has been of great help to the author in the preparation of this Aid, and for which he wishes to express his thanks.

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 23. SALEM: APR., MAY, JUNE, 1891. NOS. 4, 5, 6.

ANNUAL MEETING, MAY 18, 1891.

THE annual meeting was held in Plummer Hall, this evening at 7.30 o'clock. Vice President A. C. Goodell, jr., in the chair. Mr. Goodell opened the meeting with a few remarks in reference to the absence of Dr. Wheatland by illness, expressing the hope that the latter might recover his health so as soon to be with us again.

An abstract from the record of the last annual meeting was read.

The reports of the Secretary, Treasurer, Auditor and Librarian were read, accepted and ordered to be placed on file.

On motion of Prof. D. B. Hagar, it was voted that a copy of the Secretary's report be furnished the Salem newspapers for publication.

The Treasurer, Mr. George D. Phippen, read his twelfth annual report and in presenting it stated that he must decline further service as treasurer. Prof. D. B. Hagar offered the following vote which passed unanimously:

Voted, That the cordial thanks of the Essex Institute are hereby presented to Mr. George D. Phippen for his long-continued and efficient services as the Treasurer of the Institute, with the assurance that those services are profoundly appreciated and will long be gratefully remembered.

Dr. N. R. Morse made suggestions in reference to some suitable testimonial to Mr. Phippen which was referred to the Board of Directors with power to act.

The committee on nominations reported the following list of officers which was duly elected:

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.,
FREDERICK W. PUTNAM,
DANIEL B. HAGAR,
ROBERT S. RANTOUL.

SECRETARY:

HENRY M. BROOKS.

TREASURER:

WILLIAM O. CHAPMAN.

AUDITOR:

GEORGE D. PHIPPEN.

LIBRARIAN:

CHARLES S. OSGOOD.

COUNCIL:

WILLIAM H. GOVE,
THOMAS F. HUNT,
DAVID M. LITTLE,
RICHARD C. MANNING,
EDWARD S. MORSE,
S. ENDICOTT PEABODY,
DAVID PINGREE,
EDMUND B. WILLSON,
GEORGE M. WHIPPLE,
ALDEN P. WHITE.

Report of the Secretary.

Since the last annual meeting there have been twenty-three meetings of the Society and five meetings of the Directors.

Only one Field meeting was held during the last season, and that was at Baker's Island in Salem Harbor on June 28, 1890, by invitation of Dr. N. R. Morse and the managers of the Winne-egan House, who furnished the Institute with a bountiful collation, and did all in their power to make the gathering a pleasant one. A meeting was held in the hall of the Winne-egan at 2.30, President Wheatland in the chair. Capt. Geo. M. Whipple was elected Secretary *pro tem.* The speakers on this occasion besides the President who gave an historical sketch of the four early migrations to Salem, were Mr. John H. Sears, who gave some observations on the geological formations of the islands in the harbor, Mr. Cyrus M. Tracy of Lynn, who spoke of their botanical features, and Dr. Geo. A. Bates who spoke of the study of natural history especially in connection with the sea. Brief remarks were also made by Rev. James F. Brodie, Dr. N. R. Morse and Mr. W. S. Nevins, the latter offering a vote of thanks to the proprietors of the Winne-egan. The party numbered about seventy-five, and went to the Island in a steamer from the Willows. The meeting was considered a very successful one.

During the year papers have been read before the Society, in Plummer Hall, by the following persons:

Rev. G. T. Flanders, D.D., of New Bedford,[1] Prof. J. W. Fewkes of Boston,[2] Dr. William Thornton Parker,[3] Mr. Rosewell B. Lawrence of Medford,[4] Mr. John T. Prince of Newtonville,[5] Mr. Sylvester Baxter of Boston,[6] Col.

[1]See p. 104. [2]See p. 105. [3]See p. 105. [4]See p. 106. [5]See p. 107. [6]See p. 108.

Henry Stone of South Boston,[1] Mrs. Kate T. Woods,[2] Dr. Geo. A. Bates,[3] Mr. Sidney Perley,[4] Mr. Arthur M. Mowry,[5] Mr. William L. Welch,[6] Mr. Shebnah Rich,[7] Rev. E. O. Dyer of South Braintree,[8] Mrs. C. E. Clement Waters of Boston,[9] Mr. Arthur L. Goodrich,[10] Mr. W. A. Mowry of Dorchester,[11] Rev. James F. Brodie,[12] Prof. Ernest F. Fenollosa of Boston.[13]

These lectures have been free to the public. They have been well attended and given good satisfaction. Full reports were printed in the Salem Gazette, and other Salem papers had notices also.

Donations to the cabinets the past year number 681 from 130 different donors.[14] The names of these donors and their donations have appeared every month in the Salem Gazette and acknowledgments have been made by mail.

The cabinets of the historical department have received large and important additions during the past year, and it must be very evident to the frequenter of the Institute that we are getting sadly cramped for room to display our collections properly. An addition to our building is needed with a large room especially constructed for the purpose of exhibiting the historical relics. There should also be a room, properly lighted, for the portraits and historical pictures now the property of the Institute, and which are not shown to the best advantage in the rooms of the present building. It may seem strange that, after so few years of residence in our new quarters, we are already calling for more room and more funds ; this latter is inevitable with a society which has to depend on the generosity of its friends, the income from its invested funds not being wholly sufficient to carry on its work. This is one

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[1]See p. 108. [2]See p. 109. [3]See p. 110. [4]See p. 111. [5]See p. 111. [6]See p. 112. [7]See p. 113. [8]See p. 114. [9]See p. 114. [10]See p. 116. [11]See p. 117. [12]See p. 118. [13]See p. 118. [14]See p. 134.

reason why every effort should be made to increase the membership; while a great many of our members may not derive any personal benefit from their annual assessment, they cannot but feel that they are giving us much-needed financial help.

The manuscript department of the Institute ought to be made of use by having its treasures properly arranged and catalogued. This, I know, requires both time and money, but it is to be hoped that lack of funds will not prevent the completing of this work. A competent person should be employed in this department arranging in books, which would be easily accessible, the documents which are now in bundles and difficult to consult.

During the year we have had several special exhibits such as manuscripts, autographs, china, etc., which have attracted attention and have been the means of bringing to our collections many valuable gifts of the same character. These exhibits could by a little more publicity and by calling for loans of similar articles have been made very much more complete, but they would have required more room than our exhibit cases could afford.

It has been suggested to me that, during the coming year, it would be a good idea for the Institute to arrange for a loan collection of portraits of persons who may have been, in any way, identified with Salem; such an exhibit would be of public interest, and enough material to fill Plummer Hall ought easily to be obtained.

More than seven thousand persons have visited the old meeting house of the First Church the past year.

Twelve persons have become members of the Society during the year, while nine members have died, viz.:

John P. Andrews, James Chamberlain, Henry Hale, Edward B. Lane, Nathan Nichols, George W. Pease, Samuel G. Rea, George Russell, J. Linton Waters.[1]

I mentioned in my report of last year that the formation

[1] See p. 119.

of historical societies in the neighboring towns was evidence of an increasing interest in local history. During the past year several new societies have been started and they are all likely to prove important factors in preserving historical material of local interest. In order to show our appreciation of their efforts I would suggest that, if practicable, the libraries of these societies be furnished with a copy of our publications.

It is hardly to be expected that the public generally will look upon our work with the same idea of its importance as we do. The collecting of every kind of historical material and the properly caring for it are undoubtedly looked upon by many as a harmless hobby. There is, however, a utilitarian view of this question which I think is not brought to notice frequently enough, and that is the commercial value to our city of just such hobbies as ours. There is an ever-increasing number of visitors, who are drawn to our city not only from all parts of this country but also from abroad, purely by a desire to visit it because of its historical associations; and the more value we place upon these associations ourselves, the more care we take in the preservation of everything which can be of interest in this direction, the greater will be the interest of these visitors, the longer their stay, and the greater the benefit to our retail dealers, many of whom are appreciating the fact that such trade is worth cultivating. It seems to me that our own citizens ought to feel some little pride in showing, to the strangers within our gates, the Peabody Academy of Science, the Court Houses, the Public Library and our own Institute, as well as pointing out to them those places which are historic from their association with men and events that are known the world over.

Respectfully submitted,

HENRY M. BROOKS,

Secretary.

Report of the Librarian.

The additions to the library for the year (May, 1890 to May, 1891) have been as follows:

BY DONATION.

Folios,	85
Quartos,	196
Octavos,	969
Twelvemos,	510
Sixteenmos,	263
Twenty-fourmos,	224
Total of bound volumes,	2,247
Pamphlets and serials,	14,285
Total of donations,	16,532

BY EXCHANGE.

Folios,	6
Quartos,	34
Octavos,	259
Twelvemos,	10
Sixteenmos,	6
Twenty-fourmos,	1
Total of bound volumes,	316
Pamphlets and serials,	1,540
Total of exchanges,	1,856

BY PURCHASE.

Folios,	1
Octavos,	73
Sixteenmos,	1
Total of bound volumes,	75
Pamphlets and serials,	639
Total of purchases,	714

Total of donations,	16,532
Total of exchanges,	1,856
Total of purchases,	714
Total of additions,	19,102

Of the total number of pamphlets and serials, 6,994 were pamphlets and 9,470 were serials.

The donations to the library for the year have been received from one hundred and ninety-four individuals, and eighty-four societies and governmental departments. The exchanges, from ten individuals and one hundred and ninety-six societies and incorporated institutions, of which ninety-five are foreign; also from editors and publishers.

Among the donations may be mentioned about 200 volumes from each of the following:—Misses E. C. and M. C. Allen, Mr. O. W. H. Upham and Mrs. S. K. Whipple of Newburyport, besides over 6,000 pamphlets and serials from the latter.

The librarian regrets to be obliged to announce the death of the assistant librarian, Miss Eva K. Roberts. She took a great interest in the affairs of the library, knew what it possessed and what it lacked, and her suggestions with regard to it were always valuable. Faithful and conscientious, and with a love for her work, her death is a great loss to the library and to the Institute.

The present want of additional space for the storing of books, not only at the Institute but at the Public Library, emphasizes what was said in the report of last year with reference to marking out special lines of work for the different Salem libraries and makes more apparent the necessity for it, and the advantages that would accrue therefrom. The time is not far distant, even with this relief, when additional room must be provided for the rapidly growing library of the Institute.

It is hoped during the coming year to make some progress in preparing a catalogue or finding-list of the books as arranged by subjects in the different rooms. This would be of great assistance to the users of the library and would serve as a foundation for a complete catalogue.

The attendance at the rooms of the library during the past year has been very satisfactory and the librarian again expresses his hope that in the not distant future an increased income will make it possible to open the rooms of the Institute on the afternoons of Sunday and during the winter evenings.

CHAS. S. OSGOOD, *Librarian.*

After the reading of the librarian's report the following remarks were offered by Rev. E. B. Willson:

The withdrawal of Miss Eva K. Roberts some time since from the duties of assistant librarian of the Essex Institute on account of illness which, it was hoped, would be but temporary, but which was followed by her death on the third of May, calls for a grateful mention of her services upon the records of the Institute, and a warm tribute to her worth. Her death entails upon the Institute a loss not soon and easily to be made good. Miss Roberts had filled her position in the library since May 19, 1879, twelve years. She was competent, efficient and faithful, securing the confidence and respect both of the members of the Institute and of those who had occasion to resort to its rooms for information or assistance. By her full and minute knowledge of the contents of the library and her prompt and courteous helpfulness to those who sought access to its treasures, she greatly contributed to the usefulness of its collections, and placed many under lasting obligations by bringing its valuable stores within their reach: Therefore,

Resolved, That the Essex Institute cordially appreciates the faithful and important services rendered by Miss Eva K. Roberts as its assistant librarian for many years, that it pays deserved honor to her devotion and personal worth, laments sincerely her death, and offers to her sorrowing family its heartfelt sympathy.

Treasurer's Report.

Receipts and expenditures of the past year (condensed from the account presented).

RECEIPTS.

For balance of last year's account,		$667 45
" assessments of members,	$813 00	
" income of invested funds,	3,121 86	
" sale of publications,	468 78	
" amounts from other sources,	213 87	
Net income		4,617 51
" cash hired on note of the corporation,		1,423 75
		$6,708 71

EXPENDITURES.

By salaries of secretary, assistant librarians and janitor,	$2,198 60	
" cost of books, periodicals and binding,	395 15	
" " " publications and printing,	1,656 59	
" " " repairs and improvements,	486 44	
" paid Salem Athenæum, yearly portion of expenses,	166 22	
" cost of fuel, gas, water, postage, express, etc.,	537 75	
Net expenses,		$ 5,440 75
By paid annuities, obligations with legacies,		710 00
Total of expenditures,		6,150 75
By balance on hand,		557 96
		$6,708 71

INVESTMENT OF THE FUNDS.

For the Essex Institute building,	$28,370 69	
" Ship Rock and land,	100 00	
Real estate,		$28,470 69
For stocks, bonds and securities,	61,269 10	
" legacy from the estate of the late Mrs. Nancy D. Cole, on deposit not yet invested,	10,000 00	
Income earning,		71,269 10
Total,		$99,739 79

SALEM, MAY 18, 1891.

GEO. D. PHIPPEN, *Treasurer.*

Securities and vouchers examined and approved.

R. C. MANNING, *Auditor.*

AUDITOR'S REPORT.

The Auditor of the Essex Institute respectfully reports that he has examined and approved all of the financial accounts of the Institute for the year ending at this date.

The account of the Treasurer shows

RECEIPTS.

Balance of previous account,	$ 667 45
Income from investments, assessments, sales of publications, photographs, etc.	4,617 51
Discount of Institute note for $2,500,	2,423 75
	$7,708 71

PAYMENTS.

General expenses, salaries, publications, etc.,	$5,440 75
Annuities to beneficiaries under wills,	710 00
Paid on account of note at Salem bank,	1,000 00
Balance to new account,	557 96
	$7,708 71

It will be seen by these figures that the expenditures of the past year exceeded the general income by a little more than sixteen hundred dollars.

The securities belonging to the Institute have all been examined and found to agree with the schedule submitted by the treasurer.

They amount in the aggregate to the sum of $99,739.79 of which $28,470.69 is represented by the real estate, $61,269.10 is invested in stocks, bonds and deposits in savings banks, and $10,000 is on special deposit now awaiting investment.

The condition of the finances of the corporation bears testimony to the faithful and skilful performance of his duties by the treasurer.

All of which is respectfully submitted,

RICHARD C. MANNING, *Auditor.*

SALEM, MAY 18, 1891.

Lectures.

Monday, Nov. 17, 1890.—Rev. G. T. Flanders, D.D., of New Bedford, lectured on "Ancient Egypt" which he called the "land of mystery." After all that has been done by Egyptologists to effect a reliable history of its people, civilization and religion, it is to-day comparatively a sealed book. There are difficulties in its chronology and strange system of hieroglyphics, which make it almost impossible to construct the history of that people.

In the old inscriptions Egypt is called "the black land," the name Kam or Kem having reference to the almost black color of the soil, and the King is often mentioned as "the lord of the black country and of the red country," in other words, cultivated Egypt and the Arabian Desert. For twenty-five hundred years the history and the mysteries of Egypt were locked up in a strange, unknown tongue, the key to which had been lost. Fifty years ago the key, seemingly by accident, was found. This was near Rosetta in Egypt, where in 1799 was found a stone bearing inscriptions in three distinct characters — Hieroglyphic, Coptic and Greek. This stone is in the British Museum, while a plaster of it is among the treasures of the Essex Institute.

Beyond King Mena there is no real Egyptian history. The seals of asserted continuous history from Mena run from 7000 to 2400 B. C. Babylon and Egypt would be in origin as kingdoms about contemporary. The pyramids would have an antiquity of about 4000 years. Civilization would have taken its rise in Egypt in the course of the third millennium before Christ, and would have rapidly advanced in certain directions as it did in Babylon. The earth would at no time present the spectacle of one highly civilized community standing alone for thousands of years in the midst of races rude and unpolished.

Monday, Nov. 24, 1890.—Professor J. Walter Fewkes, of Boston, delivered a lecture on "Summer Ceremonials at Zuñi and Moqui Pueblos." The lecture was illustrated by lantern views by Mr. Newcomb.

Professor Fewkes made some remarks in opening on the antiquity of ceremonials, and gave an account of the ceremonial offerings, the time for planting, the rain dances, pottery, rabbit hunting, climate influences, in fact a very full account of the ceremonials of the Zuñians.[1]

Monday, Dec. 1, 1890.—Dr. William Thornton Parker delivered a lecture on "The Chippewa Indians."

A very interesting account was given of that tribe in particular and remarks made on the North American Indians in general.

Among other things, he said our ideas of the Indians are apt to be limited; we forget that there are over two hundred tribes living within the limits of the United States. Those who know most about the native American Indians, have the most respect for them. These Indians, unlike those of New Mexico, Central and South America, are believers in God, the Great Spirit, as they call him.

The lecturer considered the Ojibways the most interesting of the Indian races for observation and study.

Dr. Parker had considerable to say of Bishop Whipple and Gen. Armstrong, commending their labors among the Indians and the great improvements that had been made under their work and missions; he also thought the Indians had been led into warfare by provocation of the white people. War has been a struggle for existence with them.

The physical condition of the Indian was made worse for the semi-civilized appliances he had adopted by which the transition from out-door life to log-cabins overheated

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[1]See Bulletin, Vol. XXII, p. 89.

with stoves, and a life of accompanying laziness, brought physical degeneracy.

Monday, Dec. 8, 1890.—Mr. Rosewell B. Lawrence, of Medford, lectured on the "Carolina Mountains" illustrated with ninety-four lantern views.

The western part of North Carolina has been but little known to our people; its beautiful streams, forest-clothed mountains, brilliant wild flowers, soft balmy air, charming sky and peculiar people were described by the lecturer. Its mountains are the culmination of the Appalachian system, having several peaks higher than Mt. Washington. The Blue Ridge on the east and the Smokies on the west embrace a plateau elevated twenty-four hundred feet above the sea, containing six thousand square miles and intersected by several transverse ranges. In this region are found valuable forests of hard timber, rich mines of iron ore, mountains of marble of fine quality and various colors, mica in large sheets, copper, corundum and many precious stones, including the hiddenite, an emerald green gem peculiar to North Carolina.

Mr. Lawrence described Linville, where capitalists are laying out the town as a health and pleasure resort. The elevation of the town is thirty-eight hundred feet, surrounded by mountains, Grandfather Mountain being almost six thousand feet. Bakersville, Burnsville and Asheville were described, the latter the charming pleasure resort, where fine hotels and elegant residences are being erected to accommodate the north in winter and the south in summer. Visitors from both sections throng the place, each in their season. The beautiful scenery of the French Broad and Swannano rivers, Warm Springs, the railroad at Round Knob, Bald Mountain and Cæsar's Head, was pictured on the screen. The people were illustrated, many of their

curious customs described and pictures shown of the hard wood forests, the laurel, azalea and rhododendron; an account was given of the ascent of Mt. Mitchell, the highest mountain east of the Mississippi, being six thousand seven hundred and eleven feet.

Monday, Dec. 15, 1890.—Mr. John T. Prince, of Newtonville, delivered a lecture on "Common Schools." He gave first a brief history of the Massachusetts School System, answered the criticism sometimes made against it and described what was done in the best of schools, showing that the children in these schools are preparing well for the duties of life in a proper training of the body, intellect and will; the formation of a good character being most important of all.

These results are attainable in all schools under proper conditions: the employment of teachers well qualified for their work by proper training and supervision of skilled superintendents.

Monday, Jan. 12, 1891.—Mr. Sylvester Baxter, of Boston, lectured on "The Evolution of a Nation." After referring to the great social developments and changes which are now taking place in the world and which are the natural outcome of what has gone before, the lecturer proceeded to say that these changes should be helped not hindered; that the principles of evolution were always the same, and that one great factor in evolution was the friction of individual particles which at last taught the lesson that only by working in unison could the welfare of the whole be obtained. Mr. Baxter referred to Mr. Bellamy's book "Looking Backward" which he said pointed out the direction in which social development naturally lay and which, judging by the notice which had been given

to it had struck the right chord in the minds of many. He then traced the growth of a nation from its beginning and showed that the substitution of industrial combination for competition, now going on all over the world in such a marked degree, was in strict accordance with the law of natural evolution. He then attempted to prove that the only natural method by which unity could be accomplished would be by having the government, either national, state or municipal, assume the responsibility of all our industries. As it now carries our letters, why not our telegrams; as it carries our small bundles, why not our large ones and our persons as well; as it furnishes us with water, why not with food. This would be true democracy.

Monday, Jan. 19, 1891.—Col. Henry Stone, of South Boston, lectured on "General Sheridan," who was born at Albany, N. Y., of Irish parents then just arrived in this country. When he was very young the family removed to Ohio; his early life was one of poverty. After attending school for a short time he became clerk in a country store at two dollars per month; in 1848 he entered West Point and was there five years. His first service was on the Pacific coast; when the rebellion broke out in 1861 he was a lieutenant in Oregon but received the appointment of captain and was ordered to St. Louis; at the end of the first year of the war his duties were obscure and insignificant, but in May, 1862, he was appointed colonel of the Michigan Cavalry. From that time his progress was unexampled; in consequence of great skill and bravery exhibited, he rose in eight months from captain to major general.

The attention of General Grant was attracted by his conduct and when the former was made general-in-chief, Sheridan was called to the cavalry works of the army of the Potomac. His career in that position is well known;

from Winchester to Appomattox, he was always at the front, urgent, skilful, tireless, unyielding and always victorious. After the surrender of Lee, in April, 1865, he was sent to Texas to take a post on the Mexican border. When Grant became president, March 4, 1869, Sheridan was made lieutenant-general. In 1884 on General Sherman's retirement he became general-in-chief with headquarters at Washington. He died August 15, 1888, at Nonquit.

In his personal bearing and habit Sheridan was anything but the dashing, roistering character usually associated with a trooper. His success was due not to noisy demonstration on the battle-field, but to careful and diligent preparation, then to rapid and skilful action. He was quiet, reserved and painstaking; studying always how best to supply, care for and use his army so as to gain victory. So far from being high-tempered, he was gentle and considerate unless some great emergency or some shortcoming demanded corresponding expletives. The service he rendered his country was invaluable.

Monday, Jan. 26, 1891.—Mrs. Kate Tannatt Woods lectured on "Old Moravian Customs in America." It is said this lecture presents a portion of our national history which has not been fully described before, except in a few works printed by the Moravians themselves. The Moravians came to this country in 1747, as missionaries to the American Indians. They had been persecuted in Germany and Austria for their religious belief and were at last given a home on the estate of Berthelsdorf, the property of the ancestors of the late Dr. DeGersdorf for several years a practising physician of Salem. The first settlement was made in Georgia where the Indians cruelly murdered many of the colony, and the remnant went to

Pennsylvania and settled in the wilderness where the town of Bethlehem now stands. They were devoted friends of the Indians who were treacherous and laid a plot to again murder the settlers, but were frustrated by the sounding of the trombone chorale used to inform the congregation that a death had taken place.

Specimens of the chorales were rendered by members of the Cadet Band under the leadership of Mr. Missud. Some of this music dates back to A. D. 380 and 405. The scores were sent the lecturer by a prominent musician, himself a Moravian. As a rule very little is known of the trombone music in this country save by the Moravians. Mrs. Woods gave an interesting account of Moravians and described the manufacture of the wafer used by them at their communion service.

Monday, Feb. 2, 1891.—Dr. George A. Bates delivered a lecture on "The Modern Method of the Study of Natural History." He gave a *résumé* of the history of natural history from Linnæus to Agassiz, touching only the epoch-making periods and characters, such as Linnæus, Cuvier, Lamarck, Darwin and Agassiz. He spoke of evolution and its bearings upon the science of biology and upon subjects on which the naturalists of to-day are at work. These were, mainly, development (embryology, morphology, histology) and ancestry of animals as shown by the light of evolution; then he gave some thoughts concerning the laws of heredity as suggested by the phenomena presented in the process of egg fertilizations; next he spoke of the growth and improvement of the microscope and invention and importance of the microtome, also of how naturalists work. Section cutting, he said, enables the student to take animals to pieces and study their structure in detail; thus they are able to get at the

ultimate elements and see them at their work in building up and sustaining their structure. The study of the animal in the egg gives us a view into nature's workshop, where she is busy transforming the elements of earth into living organisms. The comparison of the old and the new, one represented by the forms of to-day, the other by those that have long since passed from our world, helps, by the light of the modern theory of evolution, to trace the ancestry of the forms of animal life on this earth.

Monday, Feb. 16, 1891.—Sidney Perley, Esq., spoke on "The Computation of Time." The lecturer defined the meaning of time, spoke of the early chronology of the Bible, the natural and artificial divisions of time of the Hebrew, Roman and Julian calendars (the last having been the foundation of ours), the origin of Leap year, also the change in our calendar, in 1752, when eleven days were dropped and the circumstances which led to it; he mentioned the seasons, months, weeks and days into which time is divided, and the artificial means of measuring time by the different instruments such as clepsydras, sun-dials, hour-glasses, clocks, watches, etc.

Mr. Perley exhibited Governor Endicott's sun-dial, an old pulpit, and two hour-glasses, all from the Institute cabinets, with several quaint old almanacs. He concluded by a description of local time, and an account of the changes made in 1883 from local to standard time.

Monday, Feb. 23, 1891.—Mr. Arthur M. Mowry read an interesting paper on "How English Colonies in America acquired their Government." He spoke of the political history of the English people down to the time of the first government formed in America which was the Virginia Company and the Charter granted them by King James in

1606, which gave the company power over the land from South Carolina to Maine. The speaker then went on to furnish a concise statement of the settlement of the various colonies and of the steps by which they acquired the executive and legislative branches.

A new feature seems to have gradually grown up in these colonies, for which we can find no exact precedent in English history. The executive branch consisted not in one man, the King's representative, but in the governor and council. In Pennsylvania this council had only executive power, but in the other colonies it formed the upper branch of the legislature. The words royal and propriety will show how the governors of those colonies were appointed, while in Massachusetts, Rhode Island and Connecticut, the unusual liberty again appeared in the appointing of the governor by the people.

Monday, March 2, 1891.—Mr. William L. Welch, lectured on "Recollections of the Burnside Expedition" in 1862, which resulted in the capture of Roanoke Island and Newberne, N. C., from the Confederate forces.

Five Massachusetts Regiments were in the command; in the 23rd Massachusetts Regiment, were two Salem companies: A, Captain E. A. P. Brewster, and F, Captain George M. Whipple.

Mr. Welch spoke of the regiment leaving camp at Lynnfield, in November, 1861, and described the incidents of the journey to Annapolis where the troops went on board transports on January 6, 1862. On January 15, the last of the sailing vessels entered Hatteras inlet but it was fully two weeks before the fleet got over the swash or inner bar on account of shoal water. During the stay at the Inlet the troops suffered from want of food and water. The almost continuous storm and the non-arrival of water-

vessels that had been ordered from Baltimore disturbed all the calculation of the commanding-general. He described rather humorously the suffering and inconvenience. February 5, the fleet started up Pamlico Sound for Roanoke Island; an account of the action in capturing both the Island and afterwards Newberne, showing all the difficulties that the Union forces had to contend with and of the great importance to the Union cause, of the successful termination of the expedition.

Monday, March 9, 1891.—Mr. Shebnah Rich delivered a lecture on the "Synod of Dort." He said the religious council known as the "Synod of Dort," was called in 1618 by Prince Maurice and the estates of Holland to settle differences of religious opinions that had sprung up in the Protestant churches between the Calvinists and Arminians. We well know that Constantine, ironically styled the "Great Christian Emperor," directed the first Nician Council; he banished Arius and elevated Athanasius; he set our lessons in theology. Back of the "Synod of Dort" were two central figures, Calvin and Arminius.

The doctrine of Calvin briefly stated was, "Some men shall be saved, do what they will, and the rest damned, do what they can." The early Christians borrowed the faith from the Pagan religions, which were honeycombed with fatalism. Bitter controversies culminated in the "Synod of Dort," which met in November, 1618. In political phrase it was a packed assembly, the state commissioners controlling the deputies and the divines. The Synod was in session over six months. At the one hundred and forty-fourth sitting the decision against the Remonstrants was read in Latin; those who would not subscribe to their own condemnation were banished without the privilege of seeing their wives and friends.

Monday, March 16, 1891.—Rev. E. O. Dyer, of South Braintree, lectured on "The Modern Jew." Mr. Dyer gave first an outline sketch of the Jews since the time of Christ, their dreadful slaughter under the Roman emperors and bitter persecutions in mediæval times by the so-called Christian nations; second, of their emancipation which began with the enfranchisement in England in 1753, and of the effects of this emancipation making the Jew in many respects the leader of the world.

He spoke of their great increase in wealth. The Jews are the bankers of the world; some kinds of business are almost wholly controlled by them. Reference was made to their commercial ascendancy in New York, their prominence in politics and in education in Europe.

Pantheistic philosophy and German rationalism owe their origin to the writings of Spinoza.

The Jews were allies of Christianity and Mr. Dyer spoke at some length on the modern persecution of them in Russia which had the effect of driving them from that country; also of their return to Palestine and said there were more Jews in the Holy Land to-day than returned from the Babylonian captivity; that there was a patriotic longing of the people to occupy once more the land of their fathers; in conclusion, that the Jews' part in history had not been played yet, and made reference to the rise of the Jews in modern times, having a bearing on the inspiration of the Scriptures and the interpretation of prophecy. Whatever view we take, more and more the attention of the world will be drawn to Israel.

Monday, March 23, 1891.—Mrs. Clara Erskine Clement Waters, of Boston, gave a very interesting lecture on "Dravidian Architecture."

The country formerly known as Dravida is now the

southern portion of the Madras Presidency. The language of this people was the Tamil and it is believed to have been an original tongue not derived from Brahmanical sources or affected by the Aryans; everything connected with the Dravidians is involved in mystery and yet facts enough are known to make a study of them, especially of their art, most interesting.

A Dravidian temple embraces such an area in space and includes so many colleges and various other buildings that a visit to one of the larger temples is equal to a visit to a small town. In some temples twenty thousand people belong to the service in one capacity and another, from the priest down to the grooms and elephant keepers. The treasures of the temple are large and their revenues enormous. The Orloff diamond now in the sceptre of Russia was once an eye of the golden Vishnu at Seringham and was stolen by a French deserter when the soldiers used the temple as barracks a century and a half ago; many thousands of pilgrims visit these shrines every year and the festivals are attended in great numbers. The most unusual feature of the lecture which was a description of this architecture, so unlike any other in its form and decoration, cannot be explained without pictures such as were shown by the lecturer; and even then a knowledge of the technical terms is needful for a clear understanding of them.

The Hindu religion is credited with many sects, but essentially all Hindus are Saivites or Vishnuites and both these sects are largely represented in Southern India. The temples are the same in their arrangement and only an examination of the symbols and idols reveals the sect to which each belongs; in fact some temples are decorated with the emblems of two deities in different portions which indicate that at some time there was great harmony among the

worshippers of Siva and Vishnu, which with Brahma formed the Hindu Trinity.

Monday, March 30, 1891.—Mr. Arthur L. Goodrich read an interesting paper on "The Sources of the Nile." After giving some historical and descriptive account of Egypt, Mr. Goodrich said in substance that civilization in Africa has not been either very seriously or successfully attempted until lately. The Portuguese have been there from very early times; the French have held the coast region north of the Sahara and England has held Egypt. There have been isolated trading posts in many places; the discoveries of Livingstone and Stanley have changed all this and the whole country has been divided up within ten or twelve years between six European powers who take possession either in form of "protectorates" or of "zones of influence;" these are new terms.

To establish a "protectorate" is to take possession of the country of another and administer it at your pleasure. It sounds like robbery, but is really an extension to nations of the idea that the property of incompetents must be administered for them; as to the "zones of influence," the various nations agree not to interfere with each other in their dealings with the natives throughout certain defined areas.

The reasons for this division of Africa are three in number: first, Europe is overcrowded and there are signs that America will not much longer consent to receive her overplus; secondly, competition in commerce is so extreme that new fields are an imperative necessity; thirdly, Africa is the only place left where the natives are too ignorant to defend themselves.

A description of the physical geography of the conti-

nent, quotations from Stanley and Drummond, illustrative of its surface features, descriptions of its various products and a statement of the obstacles with which colonization and commerce must contend, with special reference to the African fever, were given.

Monday, April 6, 1891.—Mr. W. A. Mowry, of Dorchester read a paper on "Some Stepping Stones to American Greatness." In introducing his subject, he said it was only recently we had discovered that we had any history. It is not the length of time which makes history, but what is accomplished. We made more history in a single century than Methuselah saw in his long lifetime.

The last century has made history that shall last while the world endures : the freeing of the slaves between 1860 and 1865, the freeing of slaves in Cuba and the emancipation of serfs in Russia. He went back to the beginning of European knowledge of America, Columbus' discovery. Three great nations held possession of sections of America at the beginning of the seventeenth century. Spain the southern portion of the continent, France along the St. Lawrence valley and England the smallest possessions, a few small colonies along the coast.

The wonderful treaty at the close of the French and Indian War reshaped those possessions, but the result was the taxation of the colonists and the Declaration of Independence. The treaty of peace at the close of the Revolutionary War was considered by the lecturer the most remarkable ; it involved three great questions the most serious of which was the boundaries. The three men most instrumental in drawing it up were John Adams, John Jay and Benjamin Franklin and it resulted in our gaining possession of the tract northwest of Ohio.

Mr. Mowry dwelt at some length on the condition of

the treaty and how it was accomplished and gave statistics of area, increase of population, wheat, corn, etc., comparing that territory with countries of Europe, proving how valuable the acquisition was to us.

In closing, he spoke of the great national problem and stated that though he was not pessimistic he realized there was a great deal to do.

Monday, April 13, 1891.—Rev. James F. Brodie lectured on "The Scotch Influence in the American Nation." The lecturer said that to trace the Scottish element in the American nation is very difficult because it so closely resembles the original English base; so far as that base was Puritan it had been subject to Scottish influence before leaving the mother country. Recently published manuscripts show that the actual beginning of Puritanism in the English church was John Knox. The Scotch element has not been so much a fertilizing as a vitalizing force in American national life; the Yankee is so much more a Yankee for all of the Scotchman that enters into his make-up. The part taken by the Scotch in American history was considered; in at least nine out of the thirteen original states there were Scotch settlements of considerable extent. In 1657 the Scottish Charitable Society was organized in Boston and to-day is probably the oldest corporate body in the country with the single exception of Harvard College. This was the first American Charity.

Monday, April 20, 1891.—Prof. Ernest F. Fenollosa delivered a lecture on "Some Lessons in Japanese Art." The lecturer said that Japan and the Japanese have been more talked about in the last fifteen years than anything except money making; yet little of value has been said or written. A superficial mocking view has for the most part

been taken, represented by the spirit of the Mikado operetta. Japanese are thought of as small, childlike and funny; Japanese art as light and grotesque. We had hoped better things of recent magazine writers, but in vain. We want some one to treat Japan seriously, as the Rev. Samuel Johnson did Chinese culture.

The very difference of Eastern thought from ourselves throws light upon our deepest problem: briefly, they have developed social instincts, we, individual; they, synthetic thought, we, analytical; they, art, we, science. Art is the flower of their life; of no other nation or people except the ancient Greeks can this be said, and this vitality of Japanese art when better known will strongly influence our future theories and methods of art education. In Japan, the humblest home, its little garden, its utensils, all of the cheapest materials, are all artistic. The commonest laborer stops to notice the beauty of natural scenery, or to pluck wild flowers. Everybody is a poet, a draughtsman, a critic. How all this contrasts with the prevailing ugliness of western life! In Japan, art is conceived as an important social function, parallel with morality and religion.

Necrology of Members.

John P. Andrews, son of John H. and Nancy P. (Page) Andrews, was born in Salem, June 23, 1805; elected a member of the Essex County Natural History Society, April 24, 1844, and died in Salem, Nov. 2, 1890.

James Chamberlain, son of Samuel and Mary (Bowman) Chamberlain, was born in Salem, May 18, 1803; elected a member of the Essex Institute, June 11, 1852, and died in Salem, June 14, 1890.

Henry Hale, son of Joseph and Eunice (Chute) Hale,

was born in Salem, Feb. 15, 1808; elected a member of the Essex Institute, July 6, 1864, and died in Salem, July 8, 1890.

Edward B. Lane, son of William and Elizabeth (Browne) Lane, was born in Salem, May 6, 1814; elected a member of the Essex Institute, Jan. 31, 1855, and died in Salem, Oct. 7, 1890.

Nathan Nichols, son of Ichabod and Cassandra (Frye), Nichols, was born in Salem, Nov. 22, 1815; elected a member of the Essex Institute, Aug. 11, 1854, and died in Salem, July 24, 1890.

George W. Pease, son of Robert and Letitia (Clough) Pease, was born in Salem, Apr. 6, 1814; elected a member of the Essex Institute, May 14, 1856, and died in Salem, Oct. 6, 1890.

Samuel G. Rea, son of Samuel and Sarah (Barr) Rea, was born in Salem, Feb. 17, 1811; elected a member of the Essex Institute, Feb. 18, 1857, and died in Salem, Dec. 17, 1890.

George Russell, son of Asa and Sarah (Leach) Russell, was born in Malden, Sept. 16, 1816; elected a member of the Essex Institute, June 7, 1854, and died in Salem, June 26, 1890.

J. Linton Waters, son of Joseph G. and Eliza G. (Townsend) Waters, was born in Salem, Sept. 4, 1826; elected a member of the Essex Institute, Oct. 21, 1872, and died in Salem, April 14, 1891.

There were, besides these, five others who were formerly active members, but were not at the time of their death.

Samuel L. Batchelder, son of David and Mehitable (Lang) Batchelder, was born in Barnstead, N. H., Dec.

2, 1817; elected a member of the Essex Institute, July 29, 1863, and died in Salem, June 2, 1890.

EDWARD C. CHEEVER, son of Josiah C. and Elizabeth W. (Page) Cheever, was born in Boston, June 28, 1843; elected a member of the Essex Institute, July 22, 1870, and died in Kewanee, Ill., Aug. 11, 1890.

JOSEPH HAMMOND, son of Jeduthun and Hannah (Homan) Hammond, was born in Salem, Nov. 30, 1806; elected a member of the Essex Institute, Sept. 2, 1863, and died in Salem, Aug. 27, 1890.

JONATHAN KIMBALL, son of Nathan and Martha (Webster) Kimball, was born in Kingston, N. H., Mar. 18, 1819; elected a member of the Essex Institute, Nov. 5, 1866, and died in Chelsea, July 17, 1890.

CHARLES OSGOOD, son of Nathaniel and Elizabeth (Cowan) Osgood, was born in Salem, Feb. 25, 1809; elected a member of the Essex Institute, July 14, 1864, and died in Salem, Dec. 26, 1890.

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Fenollosa, Mrs. Manuel,	Circulars,	42	227
Fewkes, J. Walter, Boston,			1
Firenze, Biblioteca Nazionale Centrale,		1	30
Folger, William C., Nantucket,			5
Foote, Caleb,			1
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Frankfurt-a-M., Senckenbergische Naturforschende Gesellschaft,		1	2
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Giessen, Oberhessische Gesellschaft für Natur und Heilkünde,			1
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Glasgow Natural History Society,			2
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Gould, John H., Topsfield,	Newspapers.		

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Ottawa, Geological and Natural History Survey of Canada,		2

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Regensburg, K. Bayerische Botanische Gesellschaft, .		1
Regensburg, Naturwissenschaftlicher Verein, . .		1
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Robinson, John, ... Newspapers,	20	51
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Welch, William L., . . . Newspapers, Circulars,	27	103
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Wien, Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse,		2	
Wiesbaden, Nassauischer Verein für Naturkunde,			1
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American Journal of Science.
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AN UNDESCRIBED LARVA FROM MAMMOTH CAVE.

BY H. GARMAN.

A STRANGE worm-like animal taken recently by the writer in Mammoth Cave, presents some peculiarities of structure, which render it worthy of notice.

It is a very slender, legless, cylindrical, transparent creature, the largest specimen at hand measuring about one-half inch in length. It is apparently a dipterous larva related to Sciara, but I can find no reference to anything like it in the literature of our cave animals.

The head is enclosed in a chitinous crust, and is brown, smooth and shining. It is followed by four short segments, then the diameter of the body increases somewhat, and the skin becomes finely wrinkled but shows no evident segmentation. Occasionally I have seen what appeared to indicate division of the posterior part of the body into long segments, but further examination has always failed to satisfy me on this point. No stigmata are present. The integument is very thin, and is so completely transparent that the larger internal organs can be seen through it. On ordinary inspection the skin appears to be without color, but under the microscope a faint reticulation appears, due to minute particles of pigment. At the posterior end of the body is a pair of short, fleshy appendages, one on each side of the vent.

The crust of the head is divided by sutures into three

large plates, as in other larvæ. The frontal plate is here very large relatively, and extends almost as far posteriorly as the parietal plates, which latter do not meet, as ordinarily, behind it. In this regard the cave larva is very different from the larva of Chironomus, but agrees very closely with larval Sciara. A slender projecting labrum forms a sort of proboscis, and gives the head a strange look to one accustomed to ordinary larvæ; but a close examination of this part shows it to be very much like the larger and wider labrums of Sciara larvæ. Beneath, the labrum is furnished with two parallel longitudinal series of hooks, probably of service in rasping away the vegetable matter used for food; it is supported at its base by a dark brown chitinous framework. The mouth is provided with a pair of strong mandibles, followed by a sort of labium, probably representing two pairs of maxillæ combined. Excepting the shape of the labrum, nothing about the head as thus far described would necessarily separate the Mammoth Cave larva from larvæ of Sciara which are common among decaying vegetable matter in ordinary situations.

The most singular feature of the head is a pair of large oval ocelli which, in alcoholic examples, resemble fine opals. From their prominence and size they are strongly suggestive of the staring eyes of certain deep-sea fishes, though of course their structure is very different from that of the eye of a fish. The cornea is so transparent that the tissues show clearly through it. It is not perfectly continuous with the parietal plate, and the line of separation produces some appearance of an eye in a socket. Beneath each of these enormous simple eyes is a small black speck which appears to represent the eye-spots present in Sciara and Chironomus larvæ.

The four segments which follow the head are tolerably well marked, and each has a longitudinal fold on each side.

They are not transversely wrinkled, as is the remaining part of the body.

NERVOUS SYSTEM.

A small frontal ganglion is present. The cerebral mass lies outside the developed epicranium, in the segment next following. It consists of two almost completely separate, fusiform ganglia. In twenty-two transections of a mass, only one, the tenth, showed the ganglia fused across the middle line.

The subœsophageal ganglia are much smaller, and lie opposite the anterior half of the brain. In the same set of twenty-two sections the subœsophageal mass appeared in eleven sections, beginning in the second, and ending in the twelfth.

Immediately following the subœsophageal mass are four closely approximated masses, and at a short distance posterior to the last of these is still another, thus making with the subœsophageal, six masses, all within the anterior fourth of the body. The remaining five masses of the ventral chain are widely separated in the posterior three-fourths of the body, the last being nearly opposite the point at which the Malpighian tubules enter the intestine.

DIGESTIVE SYSTEM.

The œsophagus is very long and slender. In the youngest example seen it is nearly half the length of the body; apparently it shortens somewhat with age, but in all cases is very much longer than in the other larvæ compared. It opens into a capacious ventriculus which appears to be folded on itself, and this opens in turn into a short intestine.

Malpighian tubules of a dark brown color are present, and extend forward upon the ventriculus. Four tubules appear to enter the intestine separately.

A very large, pale green, lobulated gland which overlies the ventriculus is very conspicuous. It appears to be the salivary gland. From its anterior extremities, opposite the beginning of the ventriculus, two large contorted ducts extend forward with the œsophagus. They continue separate until within the epicranium, and seem finally to unite at a median opening in the floor of the mouth. The glands probably secrete a slime, which was noticed in the wake of living individuals. Similar glands occur in Sciara and Chironomus larvæ, but are of a brown color, and the ducts are short. Larvæ of these genera have in addition to the glands a pair of salivary vesicles which overlie the brain, and send their ducts forward towards the mouth. No such vesicles are present in the Mammoth Cave larvæ.

RESPIRATORY AND CIRCULATORY SYSTEMS.

I have been unable to find any trace of spiracles or tracheæ in either Sciara or the Cave larvæ, and conclude that respiration is effected at the general surface. If present the dorsal vessel must be of extreme delicacy. I have seen nothing of it.

SUMMARY.

The features of structure to which especial attention is directed are the following, numbers 1–4 of which the cave larvæ possess in common with larval Sciara:

1. The imperfect epicranium, the head being probably represented in part by the segment which follows. 2. The location of the brain. 3. The absence of stigmata and tracheæ. 4. The great development of the salivary glands. 5. The proboscis-like labrum. 6. The large ocelli with small eye-spots beneath them. 7. The absence of salivary vesicles. 8. The great length of the œsophagus and salivary ducts. 9. The green color of the salivary gland. 10. The segmentation and folding of the

integument behind the head. 11. The absence of evident segmentation on the greater part of the body.

EXPLANATION OF THE FIGURES.

PLATE I.

A. Head and anterior part of body of larva.

B. Oblique view of dorsal side of head, showing plates and sutures.

C. Posterior end of body, showing anal appendages.

PLATE II.

D. Larva greatly enlarged, with internal organs represented as seen through the transparent body wall.

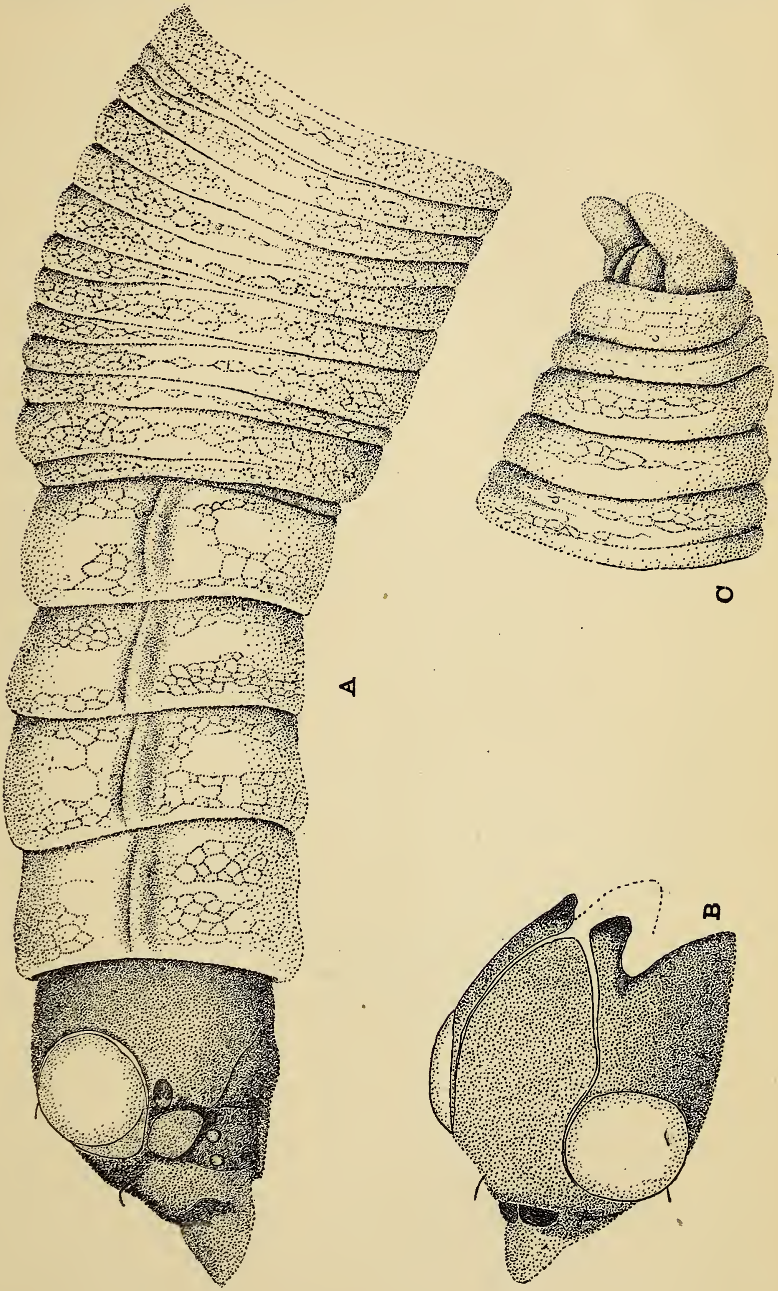
E. Ventral side of head, with parts outlined. *a*, labrum; *b*, "labium."

PLATE III.

F. Transection through anterior part of ocelli, and through mandibles. *a*, mandible; *b*, mouth; *c*, frontal ganglion; *d*, ocellus.

G. Section through middle of an ocellus.

H. Transection through segment next the head. *a*, cerebral ganglia; *b*, posterior end of subœsophageal ganglia; *c*, œsophagus; *d*, salivary ducts; *f*, lateral fold of body-wall.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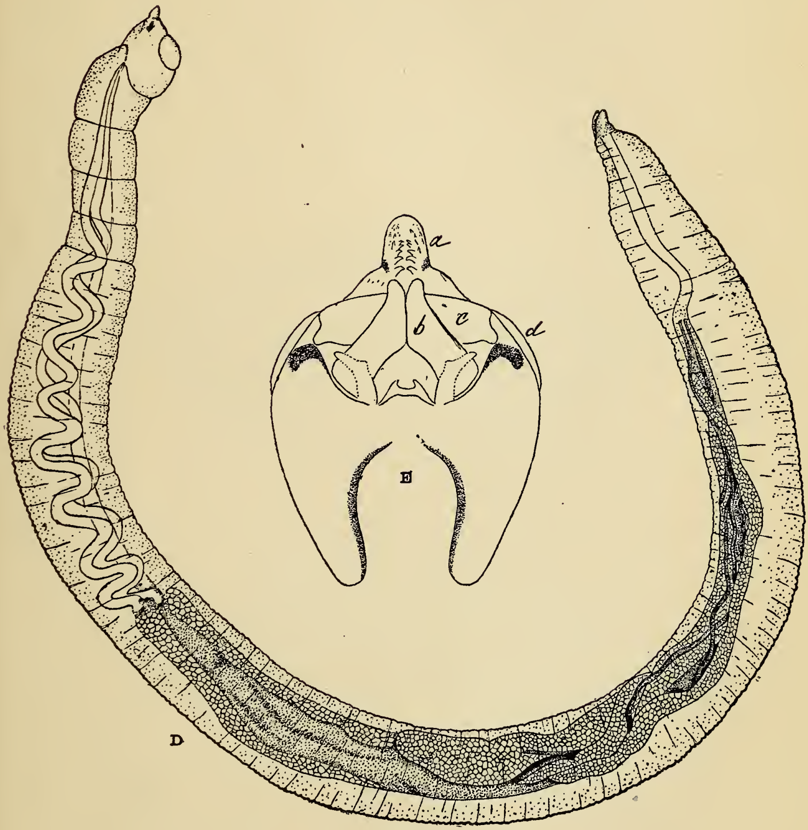
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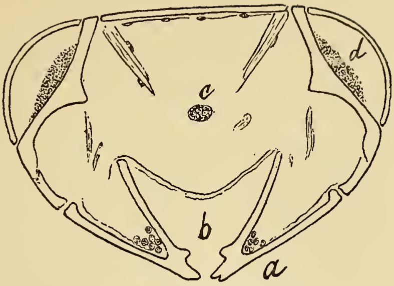

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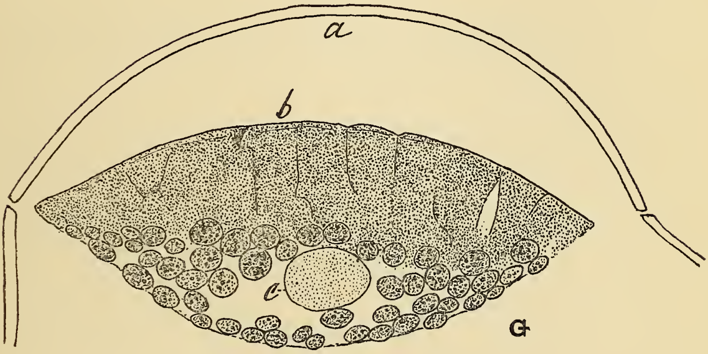

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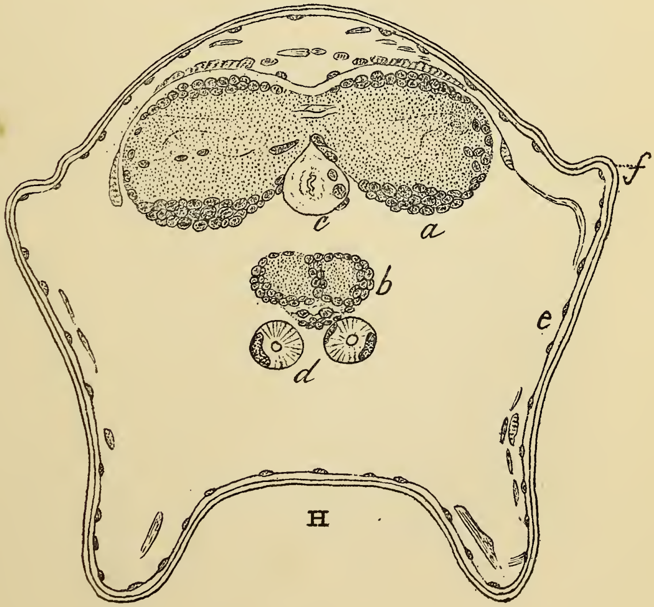

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 23. SALEM: JULY–DEC., 1891. NOS. 7–12.

ON A TORTOISE FOUND IN FLORIDA AND CUBA, *Cinosternum Baurii*.

BY S. GARMAN.

In the collections of the Museum of Comparative Zoology at Cambridge, Mass., there is a series of ten or twelve specimens of a species of Cinosternum that is not properly designated by any of the names heretofore in use. The lot was collected on the island Key West. Whether the type has a wider distribution in Florida will have to be determined later. On examining these specimens for identification, and on comparison with the allied species, *C. pennsylvanicum* and others, they are found to belong with a specimen from Cuba described by me in 1887 (Proceedings of the American Philosophical Society, page 286) as a possible representative of a new species, to which only the generic name was attached. The series at hand shows the characters then assigned to be valid for the purpose of distinction and in great measure dissipates the uncertainty concerning the extent of individual peculiarities. The

specifications from the Cuban example are here reproduced, to be supplemented by additional particulars furnished by the others taken on the opposite side of the gulf stream.

"A small turtle, sent by Prof. Felipe Poey, of Havana, possesses characters that separate it from both of the species *C. pennsylvanicum* and *C. leucostomum*, which it approaches most nearly. It is elongate; the snout is narrower and more pointed than that of the first mentioned species. The greatest length of the carapace is exactly four, its greatest width two and three-fourths, behind the middle, the greatest length of the plastron three and nine-tenths, and the width of the plastron across the pectoral shields is one and nine-tenths inches. Anteriorly the plastron is rounded; posteriorly it is truncate, with a shallow notch between the anal shields. The pair of pectoral shields, like the pair of preanals, meet on the median line in a suture of about three-eighths of an inch. A single pair of barbels close together under the lower jaw.

Color light yellowish-olive with darker margins to the shields. Head sprinkled with light spots. A narrow streak of light color passes around the snout on the rostral angle above the eye and along the side of the head to the neck."

There are several items from the Cuban specimen to be added to the above. The dark color of the edges of the shields occupies the free outer margins. From the nuchal scale backward there is a yellow stripe over each of the vertebral scales on the median line. At each side of this near the upper edge of the costals a similar stripe is to be seen, which may or may not be present on the hindmost costal. On adult examples the yellow line on vertebrals and costals gives the appearance of a low keel, though the only scale at all carinate is the anterior of the dorsal series. Carinæ are present under the stripes on specimens just

hatched, up to the half grown. A narrow streak of light color passes from each nostril over the eyebrow, above the tympanum, to the neck; a similar line goes from the eye downward and back over the angle of the mouth, below the tympanum, to the neck; and there is yet another from each nostril downward, at each side of the symphysis, to the lower surface of the lower jaw. The top of the head is freckled with light colored small spots. The specimen is a gravid female.

Of the Key West specimens there are five adults and a series of seven young ones. Excepting that they are more olive in color, the features of the Cuban are reproduced in them. The three yellow stripes, on the vertebrals and the costals, and the lines on the head distinguish them at once from *Cinosternum pennsylvanicum*. Of the latter there are now before us about fifty specimens, of all ages and sizes and from all parts of its range. On comparing a series of young ones from the Key with another from North Carolina, the former are found to be equally dark and similarly marked with yellow near the outer edges of the plastron and on the marginal shields. The northern representatives are without the three yellow stripes on the back and the cephalic lines are behind the eye, irregular and broken; there are no traces of the dorsal markings. The individuals from the Key have the cephalic lines distinct to the tip of the snout, and in but one case, almost black, are the costal stripes much reduced. On this last specimen the marginal yellow spots are confined to the under surface.

Of the distribution of the striped tortoise there is little to be said. The specimen first described was sent us by the late Professor Poey without notice of its abundance or the exact locality from which he secured it. Several collectors have secured specimens in Key West. It was

found to be tolerably abundant in the brackish ponds, where it seemed the only tortoise, during our own collecting there. It is closely related to *C. pennsylvanicum*. In the amount of differentiation, and its character, its case bears much resemblance to that of *Scaphiopus albus* from the same locality, and it is very likely there are other species similarly modified by the same influences that have caused the mentioned forms to differ so much from their kindred of the mainland. In a study of the causes of variation or of the origin of species such cases are of the greatest importance. Whether the type originated on both islands or was carried from one to the other may not be determined from the present material. The form here described is placed on record in literature under the name of the eminent osteologist, Dr. George Baur of Clark University.

GEOLOGICAL AND MINERALOGICAL NOTES, NO. 3.

ELÆOLITE-ZIRCON-SYENITES AND ASSOCIATED GRANITIC ROCKS IN THE VICINITY OF SALEM, ESSEX COUNTY, MASSACHUSETTS.

BY JOHN H. SEARS.

THE area covered by the elæolite-zircon-syenite rocks to be described is about eight miles long, extending from Collins cove, Salem neck, along the north shore to Gale's point, Manchester, with long intrusive veins and micro-veins reaching several miles farther in the granite and diorite rocks of the region. The principal outcrops are on Salem neck and Winter island on the west, Peach's point and the Marblehead shore on the south, the Cove village to Gale's point, Manchester, on the east and north, and on all of the small islands and ledges in Salem harbor within the limits included between the extreme points named. These islands are :—The Great and Little Haste, Coney island and Coney island ledges, Great Misery island, House island, the Ram islands, Chubb's island, Pride's rock and some others of less importance. The trend of this syenite rock is :—east 30° north to south-west, with the dip (N. 30° E.) variable.

In connection with these syenites are numerous patches of hornblende-granite (granitite of German authors), gabbro-diorite and typical diorite, and remnants of the older metamorphosed crystalline Cambrian sediments.

FIRST FORMED BASIC ELÆOLITE-ZIRCON-SYENITE.

Recent study of these elæolite-zircon-syenites has revealed the fact that the oldest form is a thoroughly basic rock of a greenish black color, quite porphyritic resembling porphyritic diabase. Microscopical examination of thin sections of this rock in polarized light shows that it is composed of augite, green and brown hornblende, biotite, plagioclase and an abundance of titanite and rutile microliths, micro-zircons and apatite. The porphyritic plagioclase crystals and also the hornblende areas are seen to have numerous patches of elæolite and perhaps sodalite as inclusions in them. The sodalite being isotropic and both the minerals in the section, after treatment with hydrochloric acid and staining with fuchsine in water, show the plagioclase and hornblende to contain numerous areas of these minerals which gelatinize. Some of the elæolite in these sections contains numerous feathery and fan-shaped zeolites that are probably natrolite. These are displacements of the decomposing elæolite. Everywhere on the surface this decomposition of the elæolite is seen changing the color of this mineral from an oily green to a dull lead color. The biotite is very fresh and of a red color and granular masses of titanite surround grains of titaniferous magnetite, secondary products of this iron ore.

As this rock mass does not contain olivine—olivine has not been detected in any of the elæolite-syenite rocks of this region—and as it is not found to occur in narrow veins and dykes, it cannot, therefore, be attached to the Monchiquit series as suggested by Prof. Rosenbusch (T. M. M. M., xi, 1890, p. 447, Hunter and H. Rosenbusch). I would, therefore, propose the name of Essexite for this ancient elæolite-zircon-syenite rock, which is probably the first formed rock of the elæolite-syenite magma in this re-

gion. That it was the first formed rock in this series is evident for it is cut by the micro-dykes and masses of granite, diorite, gabbro-diorites, the typical elæolite-zircon-syenite, micro-syenite veins and quartz porphyries. In a cutting of the Boston and Maine railroad, through the typical diorite of the region, I have detected a large fragment of this basic elæolite rock as an inclusion.

TYPICAL ELÆOLITE-SYENITE.

In any outcrop of the typical elæolite-zircon-syenite forms will be found in the rock mass which are clearly due to local variation. The type is a coarse feldspathic rock in which the elæolite and sodalite are seen in large blebs and patches with numerous macroscopic zircon crystals, some of which are one-fourth of an inch long, with perfect double pyramidal faces. In thin section, studied with the microscope in polarized light, the feldspars are seen to be composed :—first, of large irregular crystalline intergrowths of microcline and albite, and second, areas of orthoclase and occasional crystals of well-twinned plagioclase which is probably labradorite. The orthoclase is often filled with microliths of a dust-like character. In close proximity to the zircons, rhombic sections are often seen of a mineral of a yellowish green color which is isotropic, as yet undetermined. There are also occasional crystals and grains of ægirine which show a plechroism varying from blue green to a yellowish green, and, with the quartz wedge as determined by the negative bisectrix makes an angle of 4° or 5° with the vertical axis, some augite which shows brilliant colors in the basal section, brown hornblende, much perfectly red biotite and some magnetite. In the microscopic investigation of loose grains, the specific gravity of the minerals of the crushed rock, as passed through the 90 sieve and separated in the

Thoulet solution, gives the following portions as determined by the Westphal balance: specific gravity 2.75 separated out the mica hornblende, augite, zircon and magnetite; 2.726 removed some remaining scales of biotite with labradorite; 2.614, elæolite, plagioclase and albite; 2.595, microcline and albite, which forms the largest proportion of the crushed rock; 2.585, orthoclase and microcline, leaving sodalite and orthoclase as the residue.

In the same field with the type and usually associated with it is a fine-grained rock in which the elæolite is only detected with the aid of the microscope and where the microcline and albite intergrows are in the form of minute lath-shaped crystals. Again the feldspar is principally orthoclase. In such feldspar sections there is no elæolite. In some quite basic areas the feldspars are well-formed crystals which have all the microscopic characters of anorthoclase.

Associated with all of the other forms are masses and streaks which are foliated and schistose having all the appearance of crystallized sediments. That these schistose masses are remnants of original flows in the then unconsolidated magma of the elæolite-zircon-syenite is plainly evident by comparing them with certain well-known Cambrian crystalline sediments, such, for instance, as those at Naugus head on the Marblehead shore, Woodbury's point on the Beverly shore and the cove on the west shore of Great Misery island, which are cut by masses and veins of this syenite containing large inclusions and fragments of these Cambrian rocks with perfect outline. By these examples it will be seen at once that the former schistose rocks are totally unlike the latter and could not be mistaken for them. Other causes of variation in these syenites are due in part to the acidic or basic quality of the

magma at the time of cooling and crystallization. Excess of silica produced orthoclase, microline and albite; decrease in silica and increase in potash produce anorthoclase, and lime plagioclase.

In some places, noticeably in outcrops on the Beverly shore at Curtis' point, this rock becomes distinctly a hornblende-zircon-syenite. Here the feldspars are microperthitic intergrowths of albite and plagioclase with a large proportion of magnetite. Still farther to the eastward along the coast, at Gale's point on the Manchester shore, occur veins of this rock, from a few inches to two feet in width, which might with perfect propriety be described as ægirine-syenite for these veins are completely filled with acicular ægirine crystals, some of which are two inches long and one-sixteenth of an inch wide. The feldspar in this rock has the optical character of anorthoclase.

The porphyritic-syenite Keratophyre of Marblehead harbor and the Beverly shore is again seen as a dyke mass in the granite at a road cutting near Pride's station, Beverly. This dyke is fifteen feet wide and is exposed for a distance of fifty feet. In this rock the anorthoclase phenocrysts are completely honeycombed with inclusions of glass, while the base is composed of the same kaolinized and chloritic mass with minute lath-shaped feldspars interspersed through it, as in the Keratophyre at Marblehead. There is, again, a good outcrop of apparently the same rock in a railroad cutting between Newton and Newton junction, New Hampshire. Thin sections which I have made from this outcrop, studied with the polarizing microscope, have all of the optical characters of the Keratophyre from Marblehead harbor. This shows that Keratophyre (porphyritic-syenite) is not confined to the small area previously described in a paper by me printed in the

Bulletin of the M. C. Z. (Whole Series, vol. XVI, No. 9, Geol. Series, vol. II.)

In this belt of elæolite-zircon-syenite there are numerous masses of blackish feldspathic rocks two of which are apparently distinct. Several forms of each may readily be seen in the road cuttings and quarries. The first of these two masses, and the one most abundant on Salem neck, is a typical diorite gabbro or, to be more explicit, pegmatitic veins in the diorite, due no doubt to the flow of minerals first crystallized in this diorite magma. As a point for comparison, there is a series of road cuttings in Marblehead through the diorite of the region where these pegmatitic veins are seen in several places. I have prepared and studied several thin sections of them from these cuttings which may be taken as typical of the whole series. They have a microscopic structure as follows:

No. 1. Jersey St. Augite-diorite: Augite, hornblende, orthoclase, plagioclase, biotite, magnetite, quartz, apatite, micro-zircons and some garnets. The quartz is apparently original as it has inclusions of zircons and apatite.

No. 2. Abbot St. Augite-diorite: This has more orthoclase and large masses of apatite crystals in both the orthoclase and plagioclase; otherwise as in No. 1.

No. 3. Abbot St. Augite-diallage-diorite-gabbro: Large masses of augite, some diallage, green hornblende, biotite and drusy quartz, masses of large micro-apatite crystals, some zircons and a little apatite. The biotite is of the red color so noticeable in the elæolite-zircon-syenite, plagioclase somewhat kaolinized and a little orthoclase. Some of the augite is seen as inclusions in the hornblende.

No. 4. Jersey St. Augite-olivine-hypersthene-diorite-gabbro: This rock is perfectly fresh, no decomposition

being noticeable in any of the minerals. The probable genesis of the crystallization of these minerals from the magma was magnetite, zircon, apatite, augite, olivine, hypersthene, biotite, hornblende, plagioclase, orthoclase and quartz.

The pegmatitic diorite rock from Salem neck and vicinity in the elæolite-syenite belt has the following microscopic structure when studied in thin sections in polarized light.

No. 1. Augite-olivine-diorite-gabbro: Numerous well-twinned plagioclase crystals, some orthoclase, green hornblende, an abundance of perfectly fresh biotite, crystals of olivine, some irregular patches of quartz, and some glassy plagioclases as inclusions in the biotite and hornblende. Some of the olivine is inclosed in these hornblende masses and is much altered, forming magnetite. Numerous lime iron garnets and cubical iron pyrites are also seen as inclusions in the plagioclase. Crystals of apatite and micro-zircons are abundant in all parts of the section. The specific gravity of the plagioclase is 2.69.

No. 2. Salem neck. Hornblende-augite-olivine-diorite-gabbro: Much green hornblende, good sections of augite, some olivine, large patches of biotite, fine well-twinned plagioclase, some orthoclase, a little quartz, numerous masses of quite large apatite crystals and a few zircons. Some of the olivine is partly altered to magnetite and serpentine.

No. 3. Salem neck. Hypersthene-augite-olivine-diorite-gabbro: Much plagioclase, some orthoclase, hypersthene, augite, olivine, hornblende, biotite and a little quartz. Otherwise as in No. 2.

A comparison of the structure and minerals in these thin sections from the Marblehead diorite region with those from the diorite of the elæolite-syenite region of Salem

neck, when it is considered that the surrounding rock mass is also diorite, proves conclusively that the sections are made from rocks of the same character.

In Collins cove, Salem neck, there is an outcrop of the pegmatitic vein diorite-gabbro, varying from exceedingly coarse to very fine-grained forms, differing so much in portions of the same mass as to make three distinct types. In the first form the main mass is composed of large bluish white feldspar with a few grains of hornblende and magnetite; second, the hornblende is in coarse irregular crystals with large masses of magnetite with the feldspar scattered through it in small grains, and in the third form, the feldspars, hornblende and magnetite are about equal in amount, giving the rock at this point the appearance of a hornblende-syenite. The elæolite-zircon-syenite cuts this gabbro-diorite at several places, small fragments of the gabbro being seen in it. Numerous thin sections that I have cut of each of these forms and studied with the polarizing microscope give about the same general conclusions.

Microscopic structure, No. 1. Orthoclase with fine zonal structure, some plagioclase with very coarse twinning, a little hornblende with inclusions of augite, much biotite, with zircons that show pleochroic hallows, much magnetite and a few apatite crystals scattered through the orthoclase.

No. 2. Large masses of brown hornblende, some augite, much biotite and magnetite, some plagioclase, a little orthoclase and apatite and zircons as inclusions in the biotite.

No. 3. Orthoclase somewhat kaolinized, a little plagioclase, hornblende, augite and biotite. The augite is very fresh and numerous good basal sections are seen in the field, much magnetite, some micro-zircons, garnets and apatite inclusions in the biotite.

The same rock occurs on the southwest side of Great Misery island and sections which I have cut of it and studied give the same microscopical character, except that the orthoclase and plagioclase are much fresher. I have also cut and studied numerous sections of this rock from Woodbury's point on the Beverly shore, previously described by Dr. M. E. Wadsworth as a diallage-gabbro (Geological Magazine, Decade 3, Vol. 2, No. 5, p. 208, May, 1885), but in the sections I have made, and in others made by Dr. H. Hedsolt of the School of Mines, Columbia College, N. Y., I have been unable to detect any diallage. On the east side of the Great Misery island and on House island the elæolite-zircon-syenite cuts a massive hypersthene-diallage-gabbro (strike east 30° N. to S. W.) which is identical in microscopical characters with a gabbro on Davis neck, Bay View, Gloucester, described by Dr. M. E. Wadsworth on the same page of the Geological Magazine. This rock mass occupies the whole eastern side of Great Misery island and the west shore of House island which is about one-half mile distant, where it is seen cutting the elæolite-syenite.

Other outcrops are seen in the diorite areas of Manchester and West Gloucester, a continuation of the strike to Goose cove, Annisquam, and to Davis neck, Bay View, Gloucester. The trend, E. 30° N., of the various outcrops from Misery island, Salem harbor, is direct to the outcrop at Davis neck, on the opposite side of Cape Ann, a distance of sixteen miles.

The microscopic structure of thin sections from Great Misery island in polarized light is :—Much augite with inclusions of apatite and zircons, plates of hypersthene, green hornblende, diallage and large plates of well-twinned plagioclase (probably labradorite, sp. gr. 2.693). Extinction angle on p. 7°, on m. 19°. Saussurite is devel-

oped to some extent, and numerous inclusions of acicular microliths, which sink to the finest dust-like forms, fill this whole surface. Some of the largest of them I found to be hornblende and others are pyroxene. There are also some fluid and quartz inclusions. The bluish color and iridescence of this feldspar is ascribed to the orderly arrangement of these microliths and interpositions. There are some orthoclase and biotite and the hornblende is filled with minute grains of magnetite and rutile. Sections cut from the gabbro at Davis neck, Bay View, Gloucester, are identical in character with this last. Other sections from House island have olivine in place of hypersthene and in one section I find the biotite to be completely bleached. There are in this region numerous holocrystalline diabase dykes, some of which are cut by the elæolite-syenite, and others that as distinctly cut the syenite. At Woodbury's point on the Beverly shore this syenite is cut by a coarse porphyritic diabase which contains feldspar crystals that are from three to six inches long; and cutting through this dyke, and also cutting the syenite, is a dyke of ryolitic granite (granophyre, of Prof. Rosenbusch) that is probably the last formed rock in the region. Thin sections studied show it to be composed of quartz, orthoclase and biotite with perfect micro-crystals of hornblende which sink to dust-like proportions, very abundant as inclusions both in the quartz and orthoclase. There are also some zircons and magnetite inclusions in the biotite. Some of the hornblende microliths are of the blue glaucophane variety.

Several thin sections of the micro-granite veins that cut the elæolite-syenite, when studied with the polarizing microscope, are seen to be composed of orthoclase, some glassy plagioclase crystals, quartz veins due to segregation in part, epidote, numerous plates of polysynthetic twinned

calcite, some titanite and titaniferous magnetite. The orthoclase has inclusions of plagioclase and the plagioclase in turn has inclusions of micro-zircons. There are also numerous cubical crystals of iron pyrites in the section. Other sections of these granite veins are seen to contain some green hornblende and biotite with occasional patches of chlorite and apatite crystals. The quartz biotite and hornblende are usually developed near the contact and is an indication that these granite veins arise from segregation of newly formed minerals in cracks and crevices of the rock-mass in which they are found.

This paper is the result of quite extended field work during portions of several years and is part of a preliminary report upon the geology of Essex County in behalf of the Peabody Academy of Science.

I wish to acknowledge my obligation to Dr. J. E. Wolff, instructor in the petrographical laboratory at Harvard College, for much kind assistance and advice.

Peabody Academy of Science,
Salem, Aug. 3, 1891.

GEOLOGICAL AND MINERALOGICAL NOTES, NO. 4.

THE EXTENT AND PROBABLE THICKNESS OF THE CRYSTALLINE CAMBRIAN DEPOSITS IN ESSEX COUNTY, MASSACHUSETTS.

BY J. H. SEARS.

[*Supplementary to Notes No.* 2, *Bulletin Essex Institute*, *Vol.* 22, 1890.]

In the paper printed in the twenty-second volume of the Essex Institute Bulletin as Geological and Mineralogical Notes No. 2, I gave an account, as far as was then known of the extent of the Olenellus Cambrian rocks of this region. While that paper was in press, however, another deposit of this rock was located at Jeffry's Ledge, about twenty miles east-northeast from Cape Ann, containing numerous fossils of Hyolithes and Stenotheca, thus uniting this last-named outcrop with the Olenellus Cambrian deposits of Nahant. Since then I have found several other outcrops of these crystalline Cambrian sediments in various parts of the county. One in Rowley, chiefly in the valley between Hunsley and Bradford hills, but occasionally rising to an elevation of one hundred feet, is composed of a series of schistose argillite shales, ferruginous sandstones, and cherty limestone which is much metamorphosed in bands of light and dark color. Microscopical examination shows this limestone to be composed

of plainly stratified sediments of calcite, quartz grains, epidote, chlorite, some magnetite and limonite and to be of the same character as that at Mill cove, North Weymouth. The fossils found at this outcrop which can be identified are all in the cherty limestone. They comprise numerous fragments of species of Hyolithes and several sections of a rare (?) Archæocyathus of the lower Cambrian. These fossils were identified by Mr. Chas. D. Walcott of the U. S. Geological Survey, Washington. The strike of this deposit is 20° north of east to southwest, dip 40° west, which is nearly parallel to the strike of the Olenellus Cambrian deposit at Nahant head. Another outcrop of these Cambrian rocks is in Topsfield, in the southwest part of the town near the Ipswich river. It is composed of the same succession of schistose argillite shales, ferruginous sandstone, and a cherty limestone that is near lydite. Although fossils have not as yet been found in this limestone, numerous fossil casts are seen in the schistose argillite shales which were instantly recognized as annelids by Mr. Walcott. Some of these casts were from three to six inches long and one quarter of an inch thick. Other outcrops have been found at Archelaus hill in West Newbury at an elevation of nearly two hundred feet, Ward's hill in Bradford, in the bed of the Merrimac river in red argillite shales, and on the high hills of Methuen at an elevation of one hundred feet. Fossils which can be recognized as species have not been detected in these last named outcrops, but enough have been found to warrant the determination of these stratified beds as parts of the crystalline Cambrian sediments. The inference drawn in explanation of the presence of these Cambrian deposits scattered over the county is, that during the Cambrian period there was a vast sheet of these sediments deposited over the entire region to the depth of

some hundreds of feet; but the great amount of denudation from various causes, particularly through the agency of the ice sheet which covered this region during the glacial period, together with the frequent faulting of the strata, makes it nearly impossible to give the exact depth of these beds. They have been distorted and crumpled into anticlinal and synclinal folds accompanied by, and perhaps causally connected with, the intrusion of the granite, diorite, syenite and felsite eruptive rocks. The elæolite-syenite of Naugus Head, on the Marblehead shore, and at Woodbury's point, on the Beverly shore, are seen to cut these sediments and, being also later cut by gabbros and quartz felsites, the contact metamorphism is so complete that the old crystalline sediments are now found as hornblende and mica schists. The diorite areas of Marblehead proper, Salem, Danvers and Ipswich often contain fragments and masses of these metamorphosed crystalline sediments. One large area in Danvers and the adjoining towns occupies almost the entire valley from Locustdale, West Peabody, through Danvers Centre to Putnamville and Wenham. The trend is E. 40° N. to S. W. At Locustdale it is seen as a hornblende schist interstratified with schistose argillite shales. At Danvers Centre these beds are a true gneiss and in Putnamville and Wenham the area is all amphibolite schists. Mining shafts and trenches for water mains have opened these rock masses in several places showing the actual contact. In digging a well at Tapleyville, Danvers, on the bank of Tapley's brook a bed of typical argillaceous shale was revealed. This brook occupies the valley between the granite areas of Peabody on the south and the main mass of the diorite on the west and north and the contact of these eruptive rocks with the crystalline sediments is probably so distant that the metamorphism in them is less complete. In the

eruptive dome-shaped bosses of the hornblende granite areas of Saugus, Lynnfield, Peabody, Manchester and Cape Ann, there are numerous fragments and masses of these metamorphosed crystalline sediments. At Saugus on the east and at Lynnfield on the west of the granite there are extensive outcrops which are seen to be inter-stratified with layers of quartzite and mica schist. This mica schist is identical, macroscopically and microscopically, with the metamorphosed argillites of Nahant and Flying point, Marblehead neck. The strike of all these beds is N. E. to S. W., varying only a few degrees either to the north or east, thus showing that the intrusion of the eruptive magma was parallel to the foliation of the sedimentary beds. On Cape Ann there are numerous masses and fragments of the metamorphosed sediments in the hornblende granite bosses. One large mass, near the Loaf, a rocky point on the northern end of Coffin's beach, on the western side of Cape Ann, at West Gloucester, is several rods in extent and the foliation shows the strike to be northeast to southwest. This outcrop is below the high water line and therefore the dip could not be well made out. Another outcrop on the east side of Cape Ann, near Halibut point, is of the same type and has the same strike, with the dip 40° west, parallel to the Cambrian beds at Rowley and Nahant. The position of these two metamorphosed crystalline sedimentary beds signifies that they are remnants of an anticlinal fold of the Cambrian sediments perhaps produced by the intrusion of the eruptive granite magma from beneath them. It is not unreasonable to presume that the granite magma melted and enclosed large masses and fragments of these old Cambrian sediments, metamorphosing them into hornblende and mica schists. This theory will also explain the presence of several gneissic fragments found in the granite quarries. One such, in the Trumble quarry in West Glou-

cester, is seen as an oblong mass, twenty feet in length, tapering to a point near the surface of the dome-shaped granite boss. The enormous force exerted by the intrusion of the granite magma from beneath upon these Cambrian beds must have distorted them and left their entire surface a series of faults, cracks and crevices, thus exposing them to all the various forces of erosion and decay. The work of the ice sheet during the glacial period must necessarily have been upon these sedimentary beds scouring and grinding them to rounded boulders and fine till which were deposited all over Cape Ann and in the waters of the Atlantic ocean. One of these stratified boulders on Ten Pound island in Gloucester harbor, and another on Thatcher's island are typical examples of the larger of these fragments, while in Whale cove are great numbers of these stratified boulders of all sizes and of every shape. This would account for the absence of glacial grooves and striæ on much of the surface of the granite areas, for probably the ice sheet never touched the larger portion of the granite. Aërial decay has since destroyed all that was left of these sedimentary beds after the ice period, except such remnants as we find to-day. The absence of fossils in these remaining beds is in part due to contact metamorphism, for only twenty miles away at Jeffry's Ledge on the east, and at Rowley on the west of this granite area, we find numerous fossils to complete the geological history of the Cambrian deposits.

A large number of thin sections from all the outcrops have been studied with the microscope to determine the detrital character of these stratified beds. The results of these examinations have invariably sustained the determinations made in the field.

Peabody Academy of Science,
Salem, August 7, 1891.

BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXIV.

1892.

SALEM, MASS.:
PRINTED BY THE SALEM PRESS PUBLISHING AND PRINTING CO.,
1892.

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 24. SALEM: JAN., FEB., MAR., 1892. NOS. 1, 2, 3.

ON THE OLDER FORMS OF TERRA-COTTA ROOFING-TILES.[1]

BY EDWARD S. MORSE.

IN tracing out the ethnic relations of past races and the lines pursued by them in their migrations, the material to be studied consists not only of the actual remains of man, but also of the objects and results of his handiwork. If the objects have written characters upon them, the story to be unravelled is often easy; the very style of ornamentation betrays their relationship. Of great value to the archæologist are the enduring objects in stone, metal and terra-cotta. It will be found that those features which pertain to the households of a race, and which are successively taught from father to son, or from mother to daughter, such as methods of shooting the arrow or of weaving, are longest persistent.

In language, it is found that those words which have the deepest root often refer to acts of domestic life which pre-

[1] This paper was communicated to the Essex Institute, Dec. 21, 1891. It afterwards appeared as a series of papers in the American Architect and Building News. To the courtesy of Ticknor & Co., the publishers of that journal, the Essex Institute is indebted for the use of the illustrations in this communication.

eminently belong to the family. This fact holds good with regard to the house, and, as we see, the persistent adherence century after century to the same kind of house by migrating tribes, under widely varying climatic conditions, attests to this truth. In studying the origin of Egyptian or Grecian art, the inquirer finds his quest abruptly ended at the line dividing the imperishable stone structure from the perishable mud or wooden one that preceded it. The perishable wooden roof, however, often has associated with it a covering which is the most lasting. Rock crumbles, metal oxidizes, but the rudest earthenware is imperishable, and so the terra-cotta roofing-tiles are often the only surviving relic of a house structure. Furthermore, these objects, being always associated with the house, are intimately identified with every roof-covered family. The persistence of certain types of roofing-tiles among peoples shows the fixedness of a habit. It is a noteworthy fact that the earliest type of terra-cotta roofing-tile ever exhumed still forms the roof-covering of the greater mass of mankind to-day. The enduring nature of these objects will ultimately enable one to trace the paths followed by tile-making races in their various migrations. Wherever the Romans went, the typical Roman tile may be found, often impressed with the stamp of some Roman Legion.

Realizing the imperishable nature of roofing-tiles, and the fact that they are scattered all over the world, it has seemed to me that an inquiry into the various types of terra-cotta roofing-tiles and their geographical distribution might be of value. Unfortunately for the American student, the material to be studied is confined to the Old World, and one must go there for the purposes of investigation.

It would be an interesting inquiry to learn at what time, and where, roofing-tiles were first used. When the earliest hut-builder learned the art of sloping his roof, and

superadded to this achievement the lapping of sheets of bark, or palm-leaves, one over the other, as a rain-shield, the first steps were taken which were to lead to the roofing-tile. That the roofing-tile has a considerable antiquity is certain. Its appearance in Greece dates back to the earliest dawn of Greek art, and yet before this, in Asia Minor, there was a time when the tile was not. Schliemann, in his great work, "*Ilios, the City and Country of the Trojans*," in describing the relics found in the ruins of the first prehistoric city of the hill of Hissarlik shows the almost universal use of pottery by the people. Utensils for every-day life, terra-cotta funeral urns, large terra-cotta bowls, weights for their fishing-nets, handles for their brushes, and even hooks to hang their clothes upon were all made of pottery. "Thus we cannot be astonished in finding in the *débris* of their cities such large masses of broken pottery among which, however, there is no trace of tiles" (p. 214). He infers from this that the flat roof which is found to-day in that region prevailed at that time. Dörpfeld, in a memoir on the origin of the Doric style (a translation of which, by Mr. Edward Robinson, was published in the *Technology Architectural Review*, Vol. III, Nos. 2 and 3), says it was the invention of the terra-cotta roofing-tile that first made the construction of a sloping roof possible. It is probable that the roofing-tile was introduced into Greece from the East, fully developed, and with its introduction the roof, which had before been flat, could now be made sloping. The sloping roof must have preceded the roofing-tile by many thousands of years; at the outset, bark, straw, thatch, rough stones and similar substances were used until better devices were made, which finally culminated in the terra-cotta roofing-tile, the oldest known type of which is, by far, the most common form of roofing-tile in the world to-day.

The antiquity of the sloping roof is hinted at in the finding of cinerary vessels in the form of huts, and consequently known as hut urns. These have been found in Italy, Saxony and other parts of Europe. It is believed that they were made before the age of iron in their respective places. It is interesting to observe that all of them show, not only a sloping roof but a thatched roof as well, with

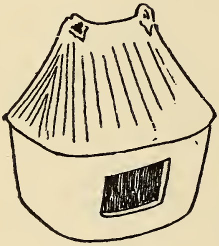


FIG. 1.

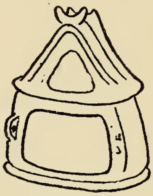


FIG. 2.

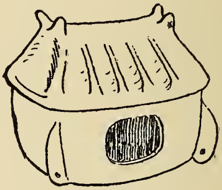


FIG. 3.

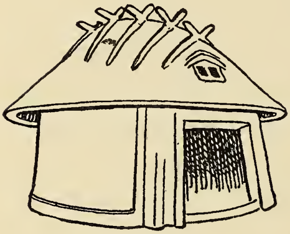


FIG. 4.

Figs. 1–3. Hut urns from Saxony in Museum für Völkerkunde, Berlin.

Fig. 2. In Vatican Museum, Rome.

Fig. 4. From Alba Longa. A better figure is given in Dennis's "*Cities and Cemeteries of Etruria,*" Vol. 1, p. lxix.

the characteristic cross-pieces on the ridge, a feature of the thatched roof which may be seen to-day in every part of the world (figs. 1, 2, 3 and 4).

The sequence in the development of the roofing-tile will have to be studied in Asia Minor, or more probably in China. From the high development and great antiquity of the fictile art in China, and the early and artistic development of the tiled roof in that country, one might be led to believe that in China—the ancestral home of so many arts—the roofing-tile originated. Graeber, in a

memoir to be referred to later on, describes what he believes to be the earliest known terra-cotta roofing-tiles. These were found in the ruins of the Temple of Hera, at Olympia, dating nearly a thousand years before Christ. This ancient tile consists of two elements, a wide under piece (tegula) slightly curved, and a narrow, semi-cylindrical piece (imbrex) which was placed in an inverted position so as to cover the junction of two adjacent tegulæ (fig. 5).

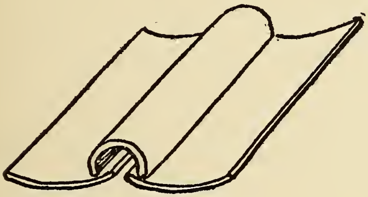


FIG. 5.

Of significance, also, is the statement that the open end of the imbrex, where it bordered the eaves, is closed by a circular disk, ornamented in rosette pattern. To find the counterpart of this we have to go to Korea and Japan and, presumably, China. Fortunately, the varied tastes of the Japanese collector have led to the treasuring-up of old roofing-tiles, either for their antiquity or because they were associated with some famous temple. In Japan, one may often see an old tile that has been dug up utilized for an ink-stone. Ninagawa, the famous Japanese antiquarian, contemplated the publication of an illustrated work on ancient roofing-tiles, to form one of the numbers of his "*Kwan ko dzu setsu.*" The lithographic plates were prepared for this number; whether the text was ever published I cannot say. Fortunately securing a set of these plates, I managed to get from the author, some years before his death, the names and dates of the tiles figured. As to the ages attributed to these there may be some doubt, but that some are Korean is a matter easily established by an expert in pottery, as the clay at once reveals the origin of the piece. Some of these were believed by Ninagawa to

be from eleven to twelve hundred years old. One is said to have come from Asiatic Turkey and to be two thousand years old. It is interesting to observe that the tiles are not only large and massive, but that those made for bordering the eaves have widened margins, variously decorated, generally in scroll pattern, and the joint tile, or imbrex, as it is to-day in China and Japan, has one end closed by a circular disk, and what is very interesting in these ancient tiles is that, in nearly every case, the decoration is that of a rosette pattern! The following figures (figs. 6 and 7) are roughly sketched from the plates in

FIG. 6.

FIG. 7.

question with their identifications as given by Ninagawa. The tiles are in every case very thick, and roughly made; in many instances the under surface bears cloth-mark impressions. Furthermore, all the specimens figured whether from Japan or Korea belong to the normal form of tile, with curved tegula and semi-cylindrical imbrex. This is the earliest form of tile known to the Japanese, and tiles of this kind are called by them *Hongawara* or true tile. This form of tile is to-day the common form of tile in Korea, China, Cochin China, India, as well as in all those countries bordering the Mediterranean. When found far-

ther north in Europe it is usually to be seen on the older buildings and is the tile most often seen depicted in mediæval paintings of places outside of Belgium and Holland.

If this form of tile really represent the earliest type, one might readily believe that its form was derived from sections of bark which must have come early into use as a roof-covering. In lapping the sections of bark from the eaves to the ridge, the concave as well as smooth surface, would be placed uppermost as forming the best water gutters. Other sections of bark, perhaps from smaller trees, would have been used to cover the joints of the larger pieces and these would have been placed with their convex surfaces uppermost. Such surmises are quite justifiable when one sees so many forms of pottery whose shapes have been derived from natural objects, as shown in the Pitt-Rivers collection in the Ethnological Museum at Oxford. [Professor Tylor, its director, has brought out in a striking manner similar relations in other departments of the collection.] In other museums, notably the museums in Stockholm and Copenhagen, the change from stone to bronze and iron shows successive derivations of form from objects first made in a ruder material or from natural objects.

As the origin of roofing-tiles is probably not lost in a very dim past, philology may throw some light on the subject. The material of which they are made is among the most enduring of man's fabrications and the earliest form must sometimes be found.

The arrangement of feathers on a bird in shedding the rain would have given a sufficient hint for the proper arrangement of material on a sloping roof. From the rough natural substances used in the prehistoric roof there came, not only slabs of wood, flat pieces of stone, terra-cotta tiles of many kinds, but worked marble tiles (620 B. C.)

modelled after the terra-cotta tile, small bronze tiles in Pliny's time, thin cleavages of slate, continuous sheet-metal roofs and metal sheets modelled after the forms of interlocking tiles.

As to the relative merit of these various roof-coverings I am not prepared to speak, nor is it with any intention of urging the economic value of this material that this paper is prepared; it seems, however, that the terra-cotta tile roof, when properly made is, all things considered, one of the cheapest and most durable. It is certainly one of the oldest and widest distributed.

Definitions.— At this point it becomes necessary to define the different types of roofing-tiles now in use. Leaving out of consideration all forms of interlocking tiles, and recent modifications of the prevailing types now so well known, we find among the older forms three distinct types.[1]

The earliest form of roofing-tile known consists of two elements, a wide tile (tegula) either square or rectangular, more or less curved in section, and a narrow semi-cylindrical tile (imbrex) usually slightly tapering at one end to fit into the wider opening of the one adjoining. The tegula is placed on the roof, concave face upward, and the imbrex, placed concave face downward, covers the lateral joint between two adjacent tegulæ. I have not been able to learn of any special English name for this tile; in Germany, it is known as the hollow tile. From the fact that it is the earliest known tile, Graeber, in his exhaustive discussion of the

[1] It would be interesting to clear up the nomenclature of roofing-tiles as some confusion exists through the same name being applied to different forms of tiles, thus the latest dictionary—"*The Century*,"—almost encyclopædic in its character, gives under the definition of crown tile the English interpretation thus: "I. A flat tile, a plain tile. II. A large bent tile or arched tile usually called a hip or ridge tile, etc." These tiles are in reality two entirely different forms of tiles and neither could be used for the purposes of the other. The synonymy would have to be worked out by some student on the ground and versed in the subject.

varieties of roofing-tiles in ancient Greece and adjacent countries, uses the name of normal tile for this form. The varieties of this tile and the different ways of using it may be designated in *this* paper as follows: When the tegula is used as an imbrex, as in China and India, it may be called the normal tile (*teg.*) When the imbrex is used as tegula, as in Mediterranean countries, it may be mentioned as normal tile (*imb.*) the ancient Grecian and Roman modification as normal tile (*flat*). The pan tile is one having a double flexure forming in section the letter ∽ and is known in some parts of Germany as the S-tile. This tile is an evident adaptation from the normal tile in combining the two elements imbrex and tegula in one piece. Originating in Belgium or Holland, one can easily conceive a thrifty and frugal people devising an economy of handling in making one piece serve the purposes of two.

The flat tile, or, as it is known in England, the plain tile, has no genetic relation to the other forms of tiles. It is simply a shingle in terra-cotta. It is rectangular in shape, flat, often secured to the roof by nailing, and used, as shingles are used, on the vertical side of a house. In roofing, the tiles are adjusted precisely as wooden shingles are by lapping and breaking joints. The German name, flat tile, will be retained as being more descriptive and probably having priority.

The following outlines (fig. 8) represent in a general way the types and varieties of roofing-tiles with their distribution. It should be understood that colonies past and present of these respective countries, so far as I know, adhere to the form of roofing-tile of the parent country. As an illustration, the few evidences of ancient roofing-tiles in this country trace the flat tile; discovered by Mr. E. A. Barber in Pennsylvania, to German settlers; the pan tile,

discovered by Dr. C. C. Abbott on Burlington Island, Delaware River, on the site of an old Dutch House, to Dutch settlers ; and, in California, the normal tile (*imb.*) to the old Spanish Jesuits.

It should also be stated that, on the bordeis of countries using different tiles, the tiles intermix ; thus France along

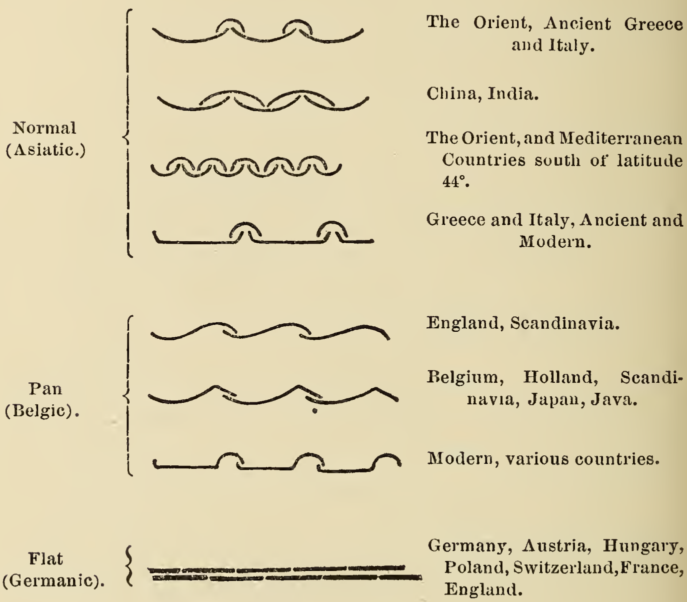


Fig. 8.

the shores of the Mediterranean uses the normal tile (*imb.*) ; and on German territory, contiguous to Belgium and Holland, the pan tile is often seen.

It will also be found that water-ways have led to the wide dispersion of roofing-tiles, and the occurrence of the pan tile in Poland is probably due to the distribution of this tile along the shores of the Baltic, as the normal tile (*imb.*) is found bordering both shores of the Mediterranean.

CHINA.

China exceeds all other countries in the world in the skill shown in the use of the roofing-tile. Moreover, China, with Korea and Japan, has treated the tile in an artistic way as no other countries have done, except ancient Greece and Rome. The normal tile is universally seen as a roof-covering from Pekin through Cochin China and Anam to the Malay peninsula.

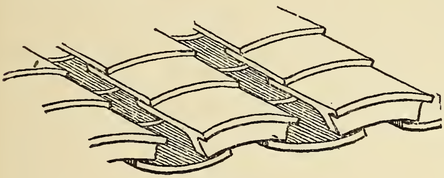


FIG. 9.

The tiles are utilized in a variety of ways as a decorative feature for the roof. Massive ridges are made of them; even gateways of common country houses will have a heavy ridge of tiles. Around Shanghai, these ridges are formed by broad, flat tiles placed on end and packed close together like books on a shelf. At the ends of the ridge they are held up by what appears to be an upturned sheet of metal. In the native city of Shanghai, a small, square, slightly-curved tile is used the same answering for tegula and imbrex. The eaves tile has a flange below; in some cases the under course of eaves tile is simple (fig. 9)

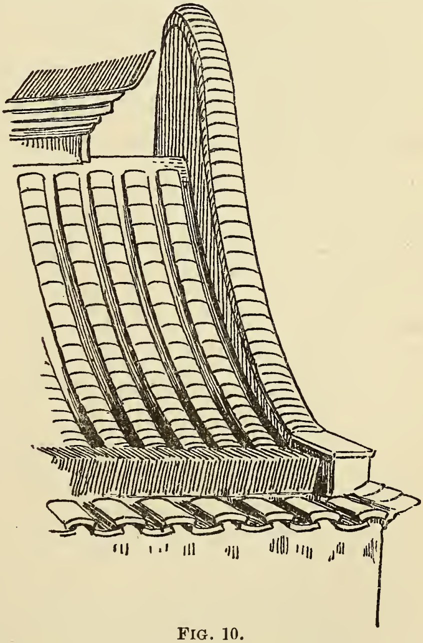


FIG. 10.

while in other cases both tegula and imbrex bordering the eaves have flanges. In the Shanghai house the wall projects slightly above the eaves, and upon this the tiles are placed on end as above described. Outside this is a cornice of tiles terminating in eaves tiles (fig. 10). On the ridge the tiles, placed on end like books, incline from the middle to both ends of the ridge. They do not appear to be attached in any way. Farther south, at Hong Kong and Canton, the eaves tiles are usually simple. At Hong Kong the imbrex is narrow and arch-shape (fig. 11), the eaves having two layers of tegulæ without margin, and the imbrex open. The ordinary Pekin tile has a nearly square tegula, 22 centimetres wide, slightly bent and quite thin. In the eaves tiles, both in imbrex and tegula, the disk and margin are made separately in a mould, and afterwards attached to the tile proper. These portions have flowers and other decorations in relief. The tile portion is

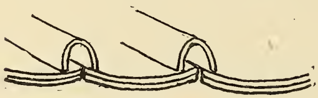


FIG. 11.

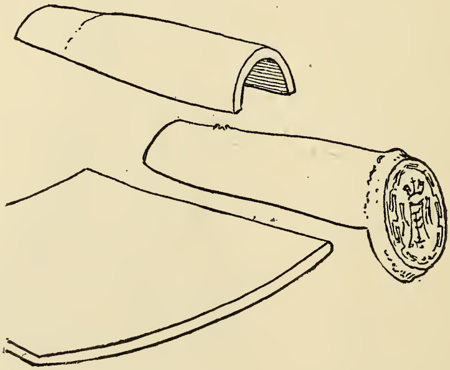


FIG. 12.

evidently made by rolling the clay into a thin sheet and then cutting out pieces of proper dimensions for the imbrex and tegula, and bending them over forms of the required shape. Fig. 12 represents specimens from Pekin

in the museum of the Peabody Academy of Science, Salem. Fig. 13 is figured from specimens of Pekin tiles in the Museum of Fine Arts, Boston. Fig. 14 represents tiles in the Summer Palace at Pekin ruthlessly destroyed by the British. These are sketched from specimens in the South Kensington Museum. Figs. 13 and 14 are glazed a light bluish-green.

A work entitled *Illustrated China and its People*, by J. Thompson, contains some conspicuous examples of Chinese architecture, notably the Tienhon-kung or "Queen of Heaven Temple" at

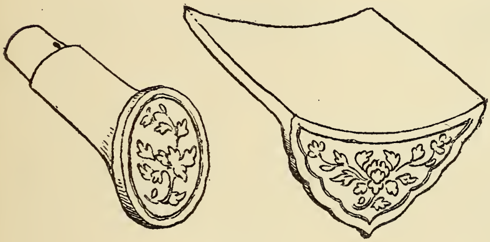


FIG. 13.

Ningpo. This wonderful structure as well as certain monumental buildings in and about Pekin, as, for example, the sacrificial-hall at the tomb of Yung-lo and the Bronze Temple at Pekin, and structures at Canton and elsewhere, all show the use of the normal tile, the eaves tegulæ in

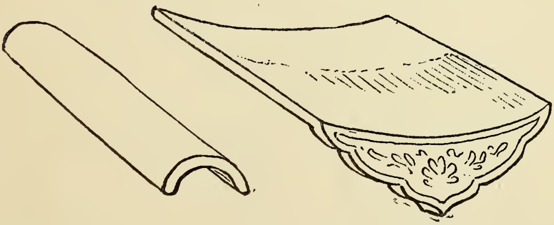


FIG. 14.

some cases having very long and pointed margins, with edges scalloped. The Imperial College, Pekin, is tiled after the style seen at Shanghai (that is, with tegula used as imbrex), but with wide, and flaring margins on the

eaves tiles, the imbrex in this case having a supplementary flange, which flares above (fig. 15).

Photographs of streets in Pekin show a roofing-tile not unlike the usual form seen in Shanghai. A modern tile

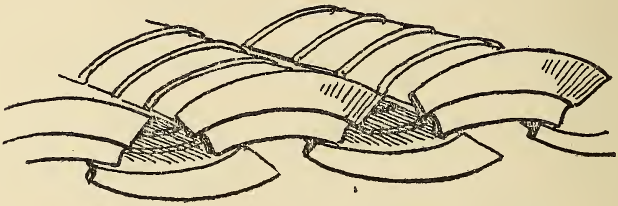


FIG. 15.

of hard, white stone-ware, richly glazed is said to be Chinese. It is a modern production (fig. 16), in Museum of Fine Arts, Boston.

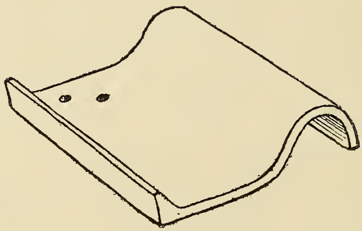


FIG. 16.

COCHIN CHINA.

In the Colonial Exhibit at the Paris Exposition, a building was erected representing a type of the Cochin China house, in fact the entire building was brought from Tonquin. The roofing-tiles as shown in this structure differed in no respects from those found in China proper (fig. 17).

KOREA.

The notes concerning the roofing-tiles of Korea, I gather entirely from Mr. Percival Lowell's interesting work entitled *Chosön. The Land of the Morning Calm.* From the illustrations of this book, reproduced from photographs made by its accomplished author, I am able to present the accompanying figures.

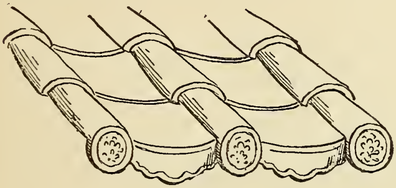


FIG. 17.

The Korean roofing-tile is of the normal type and is derived directly from China. In the common houses and shops there is no attempt at architectural effect in the way of a heavy or ornamental ridge, though a simple tiled ridge is seen on all the buildings, neither are the eaves tiles different from the others except that the tegulæ are often doubled at the eaves. The end of the imbrex is simply closed with white plaster (fig. 18.)

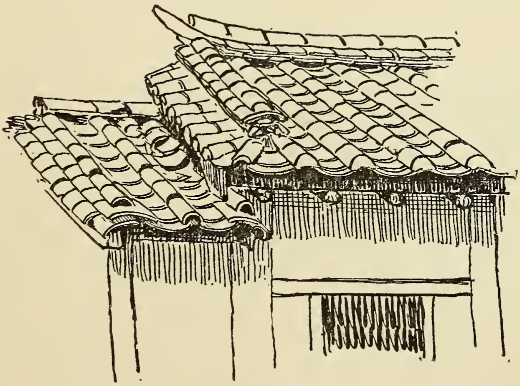


FIG. 18.

On the better class of buildings, especially certain pavilions in the new palace grounds, the eaves tegulæ have

widely turned margins which are also flaring, projecting at such an angle as to hold the snow, as shown in one of the photographs. This expanded margin has a simple design in relief. The imbrex is also closed by an oval disc, with

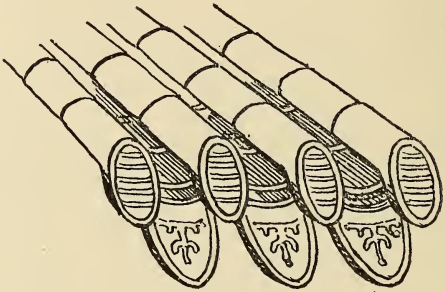


FIG. 19.

a simple design in relief. The oval form of the disc is produced by its diagonal position on the semi-cylindrical imbrex (fig. 19). In a collection of photographs taken by Mr. Lowell, and not published in his book, other forms of eaves tiles are shown associated with pavilions in the Emperor's grounds. One form is represented in fig. 20. In some buildings a few of these peculiar

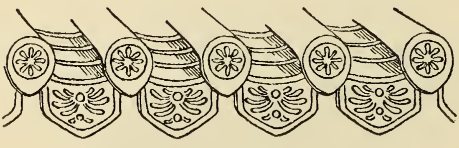


FIG. 20.

tegulæ decorate the eaves for a few courses from the corner of the roof only, while the remaining portion of the eaves show simple tegulæ. The ridge is also a more conspicuous structure than is seen on the common buildings, though not approaching the Japanese tiled ridge in size or complexity. The end of the ridge terminates in an inverted eaves tegula with broad, turned margin.

It is a curious commentary on the shiftless and poverty-

stricken ways of the people to observe in one of the main streets of the capital, awkwardly-shaped thatched roofs in juxtaposition to simple tiled ones.

Korean roofing-tiles are bedded in mud and clay as is the custom in Japan. Fig. 21 is reproduced from a tracing

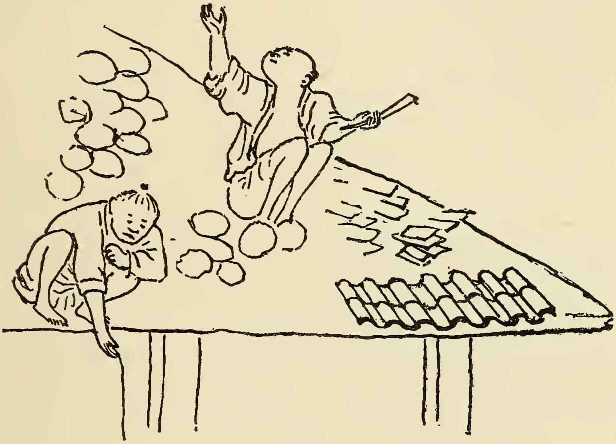


FIG. 21.

made from a native Korean drawing in the National Museum in Washington. This sketch represents Korean tilers engaged in tiling a roof. One is occupied in drawing up the tiles by means of a rope, while another is catching balls of mud or clay which are being tossed up to him from below.

JAPAN.

The form of roofing-tile varies in different parts of Japan. In the southern part the normal tile (*imb.*) is in common use, the pan tile (Yedo tile) is also commonly seen. In Tokio the normal tile reveals along the eaves either a simple tegula or one with turned margin,

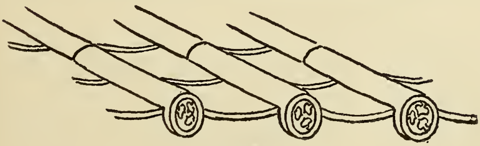


FIG 22.

with decoration in relief; the eaves imbrex is always closed by a circular disc having in relief the Tokugawa crest, or the crest of some Daimio (fig. 22). An eaves imbrex is shown in fig. 23. The usual tile in Tokio, as well as in Kioto, is a slight modification of the pan tile known as the Yedo tile. This tile like the Belgian form has one curved and one flat surface. The tiles of this kind bordering the eaves have, in one form, the plain flange, the lower edge of which, instead of following the curve of the tile, is straight (fig. 24). Fig. 25 represents a roof covered with this form of tile. In the usual form of this tile, however, the eaves tile carries upon it an imitation of the eaves normal tile, the circular disc of the imbrex portion projecting beyond that portion representing the tegula (fig. 26). In Nagasaki the pan tile bordering the edge of the gable is bent abruptly downward.

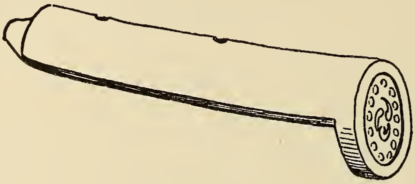


FIG. 23.

FIG. 24.

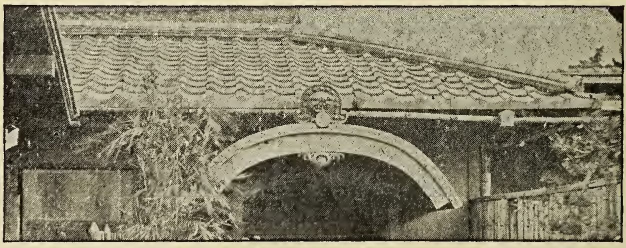


FIG. 25.

It may be observed as a curious feature that in Japan the pan tile laps to the left as seen from the ground, while in all other countries, with rare exceptions, it laps to the right. (Here is added another of the curious instances of reversal which some writers seem to be so fond of connoting.) The temples and castles in Japan are usually covered with the normal tile. When the roof is covered with metal, as is often the case, rounded ribs are introduced to carry out the appearance of the ridges made by the imbrices, even to the circular discs and turned margins at the eaves. In the province of Iwami a simple pan tile is made having a glazed surface. A glazed ridge-tile

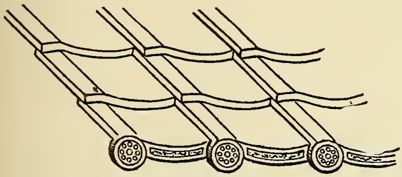


FIG. 26.

FIG. 27.

is also made in this province, angular in section, so as to rest like a saddle on the roof (fig. 27A).

Two hundred years ago a pan tile, brown glazed, was made in the province of Bizen. A temple at Uyeno in Tokio, burned at the time of the Revolution in 1868, was covered with these tiles (fig. 28). The Tokio tile is made of a dark gray clay, smooth, and presenting a nearly black surface; it is quite thick though light.

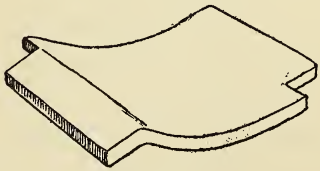


FIG. 28.

I know of no roofing-tile that approaches the Japanese tile in perfection of finish: they are also much higher priced than any other tile known

to me. In comparison, the Chinese tile seems roughly made, is thin, and often warped. The India tile is equally poor in workmanship. So accurately made are the Japanese tiles that roofs may be seen covered with a broad, slightly curved tegula, no imbrex being used (fig. 29). These tiles, like all Japanese tiles, are bedded in mud, and in this instance the edges of the tiles are so straight as to meet together quite perfectly. Simple tegulæ are often used as ridge-tiles on a thatched roof (fig. 27B).

In the better class of tiled roofs it is customary to point with white plaster a number of courses of tiles from the

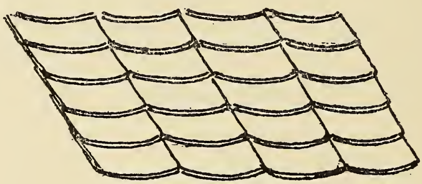


FIG. 29.

ridge, the hip and the eaves, and in some cases the whole tiled surface is treated in this way.

The Japanese ridge is often a very complex and remarkable structure, sometimes of ponderous proportions, with supplementary ridges running down on the hips, and even diverticular ridges near the eaves. These are, or ought to be, built up of tiles and plaster, but oftentimes the bulk of the mass is made up of a carpenter's device consisting of a framework covered with boards, the sides plastered white and having all the appearance of a solid mass of plaster and tiles (fig. 30). The terminal ridge-pieces are often marvels of the tile-maker's art.

Mr. Kashiwagi, a Japanese antiquarian of Tokio, told me that he had records of green-glazed roofing-tiles of the

normal type being used in Japan over a thousand years ago; whether made in Japan or imported is not known. Ninagawa figures in his work on Japanese pottery fragments of what he considered the first glazed pottery made in Japan, and these show a green glaze.

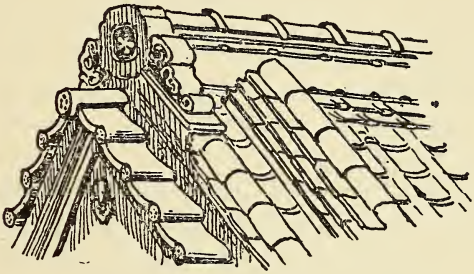


FIG. 30.

In the following figures are shown, by way of comparison, a Japanese (Nagasaki) tiled roof (fig. 31) and the roof of the Temple of Hera, at Olympia (fig. 32), as restored by Graeber. The terminal ridge-tile, the imbrex closed by a circular disc (not, however, represented in fig. 31), the plain tegula at the eaves with simple margin,

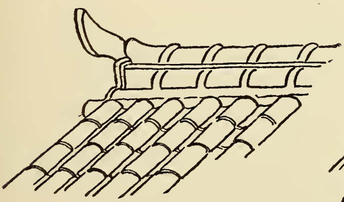


FIG. 31.

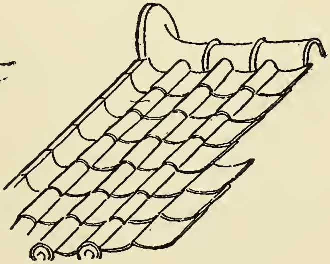


FIG. 32.

present striking resemblances between roofs separated by nearly three thousand years in time and thousands of miles in space. (For further information regarding tiled roofs in Japan see Morse's *Japanese Homes and their Surroundings.*)

INDIA.

So far as museum specimens and photographs have enabled me to judge, the roofing-tiles used everywhere in India are of the normal type (usually *imb.*). Judging by the form of the imbrex as shown in photographs of Bombay houses, it would seem that in their manufacture a tapering cylinder of clay is turned on a potter's-wheel, and then cut in halves longitudinally, and these halves are used as tegula and imbrex. As an evidence of this, in the Bombay roof the tiles bordering the eaves terminate as cylindrical tiles, the tapering end entire and projecting slightly beyond the eaves, while the larger end is cut half-way through to accommodate the overlapping and inverted tiles

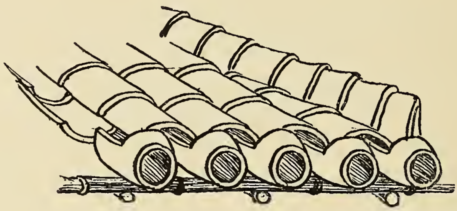


FIG. 33.

that cover the under courses, as shown in fig. 33 (sketched from a photograph in the India Museum, London).

In Madras the normal tile (*teg.*) is used. In some cases the eaves have two thicknesses of tegulæ below and three above (fig. 34). The tiles used at Poona, near Bombay, are a variety of the normal type (fig. 35), the tegulæ being flat with upturned edges.

This tile is 23 centimetres long; the exposed edge is 14 centimetres wide and tapers rapidly to a width of 9 centimetres, with rounded ends. The imbrex is semi-cylindrical, 28 centimetres long, 10 centimetres across at the exposed end, and tapers to a width of 6 centimetres.

These tiles are light-colored, porous, and very roughly made. The specimen figured is in the great Indian collection made by Dr. Jagor, now in the Museum für Völkerkunde, Berlin. From a few photographs that I have seen of Indian houses there seems to be no modification of the eaves tiles for architectural effect.

The English buildings in Agra and an English church in Bombay, and doubtless English buildings in other parts of the empire, are covered with the ordinary pan tile.

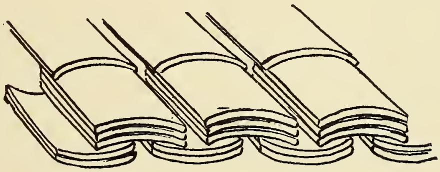


FIG. 34.

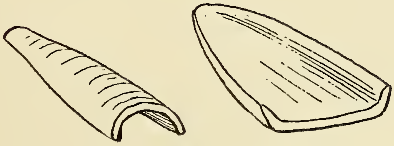


FIG. 35.

CEYLON.

At Columbo the normal tile (*imb.*) is seen, the eaves tile having a double imbrex. At Candy, the famous temple is roofed with flat tiles having square ends, presenting in the photograph the appearance of a shingled roof. Other buildings near the temple are covered with the normal tile (*imb.*).

PERSIA.

Judging by the few pictures and descriptions available, the normal tile (*imb.*) seems to be the one in common use. In former times, judging by the high skill attained by the

Persians in brick enamelling, and the wonderfully glazed, flat tiles for interior decoration, the palaces and mosques must have presented a most beautiful and brilliant appearance. In the article "Tiles" in "*Encyclopædia Britannica,*" it is stated that the roofs of some of these important structures "are covered with magnificent, lustrous tiles decorated with elaborate painting, so that they shine like gold in the sun. They were especially used from the thirteenth to the fifteenth century." From this statement one gets no idea of the form of tile used.

The high attainment reached in relief work and colored enamels by the early Persians may be seen in the wonderful wall made of brick brought back from Persia by M. Dieulafoy, and displayed in a special room at the Louvre. On this wall are depicted in colored enamels a number of archers, known as the Susa archers.

TURKEY.

Photographs of buildings in Constantinople and other places show the universal use of the normal tile (*imb.*); the semi-cylindrical ridge-tile accompanies it. The Constantinople tile seems slightly more angular in section than that of Italy.

SYRIA.

In Jerusalem and Jaffa, the normal tile (*imb.*) seems the only roofing-tile in use. The joints between the tiles are often pointed with plaster.

EGYPT.

When a tiled roof is seen, it is covered with the normal type (*imb.*). The courses are laid close together, as in the modern Greek roof, and, as in the Greek roof, the interstices between the tiles at the eaves are filled with plaster.

GREECE.

The normal tile is the only form seen in Greece and the adjacent islands. The usual narrow form (*imb.*) common to the Mediterranean countries is also the prevailing form in Greece. In many instances the two elements of the tile are less cylindrical than those of Italy. Greece is the only country in Europe in which the broad, curved tegula with narrow imbrex is seen. In Eleusis, roofs covered with this typical normal tile occur. In Messenia the wide tegula is used as an imbrex, as in China. On the old cathedral at Athens, a Byzantine structure dating back to the early part of the thirteenth century, a large curved tegula with narrow imbrex is found (fig. 36); all the courses are thickly plastered and bear the marks of great age, and at the eaves the imbrex is supported some distance from the tegula by a mass of stucco. The dome is also covered with the same kind of tiling, the tegulæ being cut tapering as they approach the apex of the dome, the imbrices standing out as prominent longitudinal ribs from the apex of the dome to its base. There is also another Byzantine church in Athens roofed with the same kind of tile.

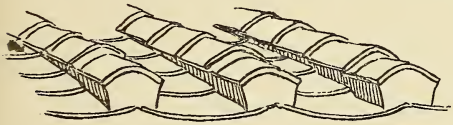


FIG. 36.

In the modern houses at Athens and in other places the tiles are more flattened than is usual with this form, and at the eaves the upper and lower elements are separated by a considerable space and filled with white stucco. This presents the appearance of an imbricated edge along the eaves. With the exception of certain examples in Spain this is the only attempt, so far as I have been able to ascertain, at the ornamentation of the eaves tiles seen west

of China. In some places in Greece, as at Eleusis, for example, the tiled roof shows broad bands of white painted tiles at the ridge, hip and eaves, with an intermediate band in the middle of the roof; other bands cross these at right angles to the ridge. In the photographs rectangular areas of dark tiles show between these white bands. A treatment of the roof presenting a similar appearance is often seen in Japan and Siam, in these cases white plaster being used. At many places, as at Delphi, Dimitzana and Catania it is customary to place upon the tiles angular fragments of stone; these are placed parallel to the ridge, hips and eaves. Occasionally the same treatment may be seen in Constantinople and Stamboul.

In none of the various forms of normal tile seen in Greece to-day is there an eaves tegula with turned margin, or an eaves imbrex, closed by a circular disc. In all other respects, however, the normal tile approaches nearer the Asiatic tile, as seen in China, Cochin China, Korea and Japan than does that of any other country west of these regions unless we except the rough example from Poona, India, where the tegula is wide.

ANCIENT GREECE.

A general idea of the roofing-tiles of ancient Greece may be gleaned from the article "Tiles" in the *Encyclopædia Britannica*. Under this title the terra-cotta and massive marble tiles used on monumental buildings are briefly described and figured.

In a memoir entitled *Terrakotten am Geison*, etc., by Dörpfeld, Graeber, Borrmann and Siebold, a minute description is given of the terra-cotta roofing-tiles, ridge and terminal ridge-tiles, antifixæ, etc., of certain ancient Grecian temples. Of particular interest is the description of the roofing-tiles found on the site of the Temple of Hera at Olympia. This temple is one of the earliest ex-

amples of Greek architecture dating back, at least, eight or nine centuries before the Christian era. It will be noticed that this earliest known roofing-tile which Graeber designates as the normal tile, has a wide curved tegula, and a narrow semi-cylindrical imbrex (fig. 5) being identical with the Oriental one (compare fig. 11). The size of the tegula was 1.50 metres in length by .50 centimetres in breadth. Graeber says that this tile, common in the Middle Ages, is still much used to-day; it is particularly associated with convent roofs. I have before remarked that this normal tile of Graeber's differs from the normal tile in that region to-day in having a wide tegula and narrow imbrex. The nearest approach to this in the Middle Ages is the one seen on the old cathedral at Athens.

Graeber states that these early roofing-tiles of the Temple of Hera were covered with a black glaze; he also says that glazed tiles have been determined from Argos and Mycenæ. The tiles, however, on the Temple of Hera at Argos were not glazed. It is also stated that a few monumental buildings in Sicily, Italy, Peloponnesus and Athens reveal the use of roofing-tiles. Besides this primitive normal tile described by Graeber, there is another form of tile which must be regarded as an outgrowth from the normal tile, inasmuch as a narrow imbrex covers the line of junction between two adjacent tegulæ. In the last mentioned form the tegula is rectangular in shape, flat, with lateral edges turned upward as shown in fig. 37. Graeber describes two varieties of these, one found in Greece in which the upturned edge stands at right angles to the flat portion as shown in fig. 38. In the earlier forms of this variety the reflexed edge is low and is accompanied by a semi-cylindrical imbrex. At a very early date, however, the angular imbrex makes its appearance, and from the time marble tiles were adopted from the terra-cotta form, this becomes the definitive shape of the

imbrex. The other variety is peculiar to Sicily: in this the upturned edge preserves a convex surface; this form is also found in lower Italy, but is not exclusive, as other varieties also occur in that region. Fig. 37 represents the Sicilian form.

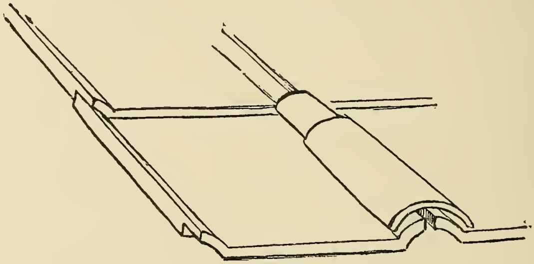


FIG. 37.

In the Boston Museum of Fine Arts, are fragments of tiles from Assos, Asia Minor, dating not farther back than the Roman epoch. The following figure (fig. 38) is a restoration showing the appearance of this tile in position.

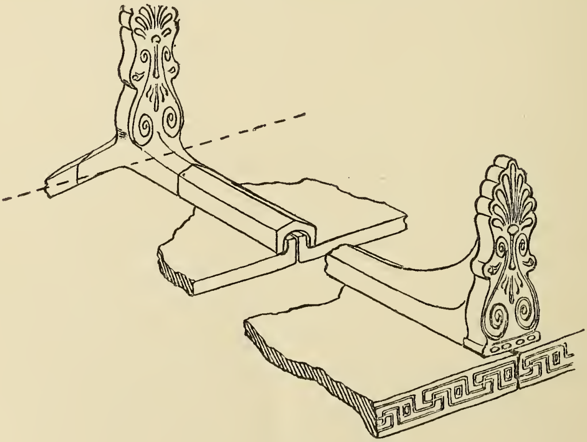


FIG. 38.

It will be seen that the eaves tegula has its margin turned down and bears upon its face an ornamental design in re-

lief. The eaves imbrex has its end closed, not by a circular disc, but by a broad ornamental piece standing erect with anthemion decoration in relief. These designs vary greatly in different fragments, but are all of the same general nature. The roof imbrex continues the same width over the ridge spanning it like a saddle, and has a similar process projecting upward at the crest with decoration in relief on both sides. A ridge-tile of the form of a plain imbrex probably covered the junction of the tegulæ at the crest. This treatment of the ridge-tile has no parallel in the Orient so far as I know. In another form the ridge-tile is semi-cylindrical bearing a leaf-like crest decorated in polychrome; on the lower edge a portion is cut out to admit the ends of the semi-cylindrical imbrices as they approach the crest (fig. 39). This figure is copied from

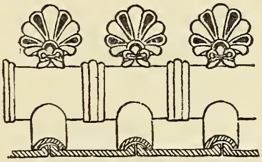


FIG. 39.

Boetticher's work on Olympia (p. 207) and represents a tile from the treasury of the Geloans (Sicilians) at Olympia. In the minute investigation of this subject made by Graeber, he often alludes to the great variety in the minor details of the roofing-tiles seen on these ancient sites. Referring to Olympia, he says: "still more striking than the diversity of the clay material is the multiformity of the kinds of construction presented by the antique roof in Olympia. The terra-cotta roofs there offer such a wealth of forms that one has well-nigh to doubt that all of them sprang from a handicraft native to Olympia, or to the district of Elis, and to believe rather that they repre-

sent an aggregation similar to that in a museum of all the constructions customary in Greece, Lower Italy and Sicily, and this supposition has verified itself, for further studies showed that at the places in Greece and Italy, which we visited, certain particular kinds of construction are used almost exclusively, and that the variety and multiplicity of forms found at Olympia occurred nowhere else to the same extent."

Speaking of the marble roof, Graeber says: "The general system and scheme of the antique marble roof is well known through many publications. This system, however, has not been invented for the marble roof, but had its prototype in the clay-tile roof. The antique roof had to pass through centuries of evolution till it attained that perfection which we admire in the Parthenon of Athens, and the Zeus Temple of Olympia and many other edifices. As regards elegance, one may even say subtility of perfection, the Greek tile roof ranks even above the marble roof."

I cannot forbear quoting further from this valuable memoir of Graeber's. He says in regard to the attachment of tiles on the roof: "A securing of the tiles on the rafters by means of nails did not take place; only the lowest tile, next to the gutter, was always secured by iron or bronze nails to the rafter. All tiles with nail-holes, therefore, belong, without exception, to the gutter, and just so little did the tiles have projections for hanging them to the laths as it is assumed erroneously of the marble roofs, but they rested directly on the rafters, and maintained themselves in their position in part by their weight, in part by supporting themselves through the next lower tile by means of the cutting on their lower surface. This may have occasioned, under certain circumstances, a heavy strain; for instance, a sliding down, involving even the lowest gutter or moulding tiles." And he refers to the

condition of things at the Zeus Temple at Olympia as due to the sliding down of the tiles in this manner.

Graeber presents a restoration of the edge of the roof of Temple C. Selinus, Sicily (fig. 40). Here the elevated process or antifixa of the eaves imbrex is now detached, and forms a separate piece, which is nailed to the stone coping, and the turned margin of the eaves tegula is also separate, and is nailed to the face of the coping-stone. These various elements were moulded in relief and beautifully decorated in polychrome. This temple is supposed to date from 600 B. C.

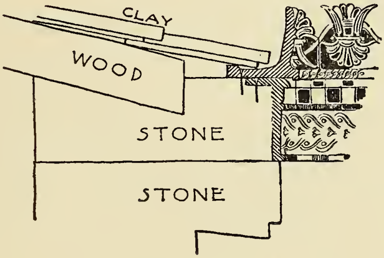


FIG. 40.

Reference has been made to the marble tiles following the form of the later terra-cotta tiles. It has also been shown that the pan tile of Europe has been derived from the normal tile by combining in one piece the upper and lower elements. It is interesting to observe that in the marble tiles of ancient Greece the same combination is shown in some, where the imbrex and flat tegula with upturned edge are combined, and, curiously enough, the lap is to the right, as followed by the pan tile of Europe.

ITALY.

Throughout Italy, the usual covering for house roofs is the normal tile (*imb.*). The tiles vary somewhat in size. In Pavia and Ravenna the tiles are quite large, and in

section somewhat angular. In Verona, the tiles appear quite long. Photographs of Parma, Milan, Pavia, Bologna and other cities reveal minor peculiarities in the manner of tiling. In some cases courses of imbrices are close together, and the tiles are often crowded in the courses from eaves to ridge. There is no alignment of the tiles, as in Chinese, Korean and Japanese tiling, and the work always seems slovenly done.

In Verona, fragments of tiles are inserted in the inter-spaces between the ridge-tiles and their junction with the roof-tiles, as shown in fig. 41. At Certosa and Milan rows of imbrices with their concave faces uppermost are placed between the rows of imbrices in their normal position. In other words, after the roof is tiled in the ordinary way, an additional layer is put on in an inverted position between the rows of imbrices. The roofs are low pitched and this extra layer probably offers an additional security.

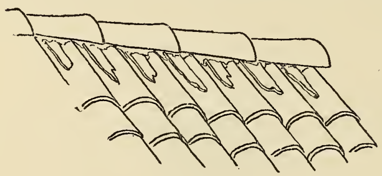


FIG. 41.

Beside the normal tile there is often seen a broad flat tile, with lateral edges turned up accompanied by a semi-cylindrical imbrex. This tile is used in Rome, Florence, Sienna, Pisa, Ravenna and doubtless in other cities of Italy. An examination of a large series of photographs shows it to be more common in central Italy. On the roof slopes the broad tegula may be seen in certain courses used as an imbrex (fig. 42).

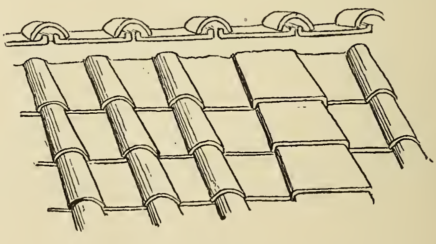


FIG. 42.

This broad tile bedded in stucco is also used as a ridge-tile as shown in the last figure (fig. 42). This tile is a direct survival of the ancient Roman tile which in turn has been derived from the Greeks, unless both Greeks and Romans were indebted to the Etruscans for it. The modern tile is much smaller and thinner. It is often represented in the pictures of old Italian masters (fig. 43). (From a painting by Botticelli in Dresden gallery.)

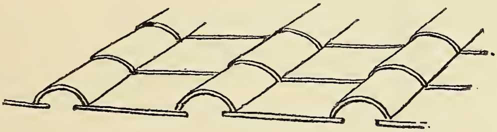


FIG. 43.

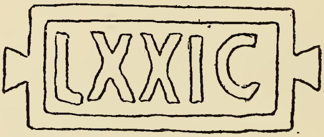
A modern tile, probably interlocking, quite small in size, but made somewhat after the style of the tile last described, is occasionally seen. The tegula tapers much more abruptly and is used as an imbrex.

ANCIENT ITALY.

The ancient Roman tile consists of a large flat rectangular tegula with lateral edges turned up, and a narrow semi-cylindrical or angular imbrex, both tegula and imbrex being heavy and massive.

At the Antiquarian Museum at Zurich are a number of ancient Roman tiles; these have the lateral edges abruptly turned up, the imbrex is angular in section (fig. 44). On the exposed and lower edge of the tegula are a few curved marks as if made by the fingers. As these marks are seen on similar Roman tiles at the Royal Antiquarian Museum at Brussels and elsewhere, it would seem to be a special furnace-mark of the maker, or possibly to indicate the lower end of the tile. On the under surface of each tegula,

inclosed in a rectangular panel is impressed the Roman characters LXXIC. This was the mark of the 21st Legion, showing that the Roman soldiers were accompanied by tile-makers, as well as by those pursuing other trades. At the museum last named are some ancient Roman tiles resembling those mentioned by Graeber in the memoir previously alluded to. In these tiles the turned edges differ slightly from those figured by Graeber; the



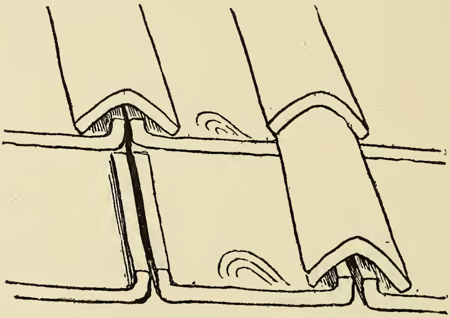


Fig. 44.

lower corners were recessed, however, to fit on the tile below, and the turned edge ceased within a short distance of the top of the tile (fig. 45). There were no perforations for pegs or nails to hold the tile to the roof as is described in similar tiles figured by other authorities.

In the ancient cemetery of Marzabotto, near Bologna, the contents of which have been figured and described with great fidelity by Count Gozzadini, a number of terra-cotta

roofing-tiles were found. These were made after the flat Roman pattern, but were remarkable not only for their massive size, but for certain structural peculiarities, not seen in the typical Roman form. The tegula measured 1.07 metres in length by .80 centimetres in width (fig. 46A). In some examples the upper inferior margin was turned at right angles, and this was strengthened by a thin brace as shown in the fragment (fig. 46D). On the superior surface of the tegula a rounded knob was present (fig. 46E). This was perforated for the admission of a bronze nail having a thin concavo-convex head (fig. 46F),

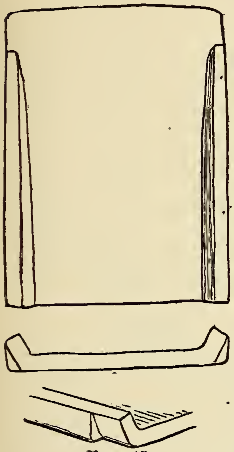


FIG. 45.

which conformed to the shallow and lenticular knob on the

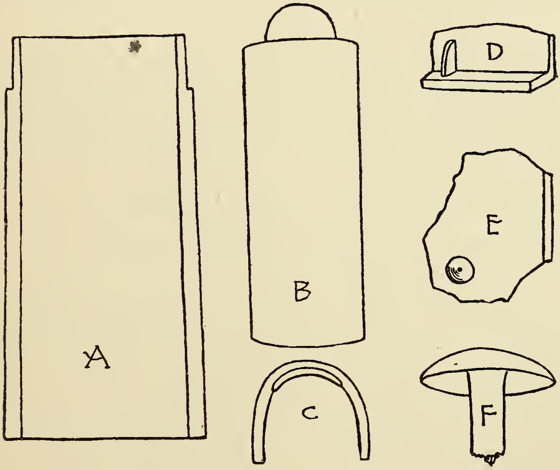


FIG. 46.

tile; by this device the rain was more thoroughly excluded. The imbrices varied in length, the longest being .82 centimeters in length, with a width of .28 centimeters and a

height of .26 centimeters (fig. 46BC.) (The drawings as published do not show these proportions). Many of these fragments show traces of polychrome decoration on their exposed surfaces.

Concerning the age of the Marzabotto cemetery, George Dennis in his *Cities and Cemeteries of Etruria* (Vol. II, p. 543), says "we may safely refer the antiquities found at Marzabotto to the latest days of Etruscan independence, north of the Appenines, which came to an end on the invasion of the Boian Gauls, at the beginning of the fourth century B. C."

SICILY.

The normal tile (*imb.*) is the common form throughout the island. In one old building at Palermo, the tiles are crowded together, from the ridge to the eaves. At Taormina the eaves tiles are pointed with plaster.

SPAIN.

In this country the roofing-tiles everywhere seen belong to the normal tile (*imb.*). These are usually semicircular in section and much larger than the forms farther east. At Burgos the tiles are crowded on the roof, at the eaves the ends of the tiles are pointed with plaster. At Granada a similar treatment of the eaves tiles is seen. In one portion of the Alhambra, light and dark tiles are arranged on the roof in such a way that a clearly marked zigzag pattern is carried out. In another and older portion of the Alhambra, the tiles, instead of being roundly curved in section, are somewhat angular. At the eaves, the imbrices are doubled and, between the upper and lower imbrex, separated by the space equal to the width of a tile; a mass of white stucco or plaster is interposed. As there appears no break in the alignment of the tiles from the eaves to the roof, the lower course of eaves tiles probably rests horizon-

tally on a projecting cornice, the plaster diminishing in thickness backward for a few courses as shown in fig. 47. An evidence that this is so is shown in an end view of another portion of the building, where a cornice or shelf, projecting below the eaves, has settled by the weight of plaster and tiles above.

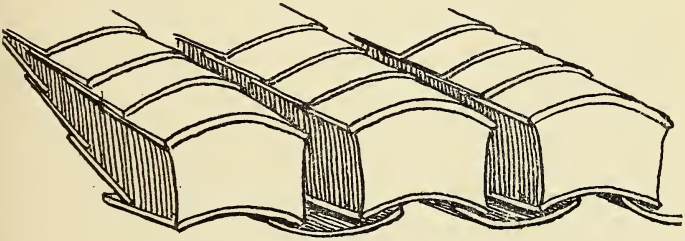


FIG. 47.

At Seville, Alcazar and other places, the courses of tiles are slightly separated at the eaves and the spaces enclosed by the tiles are filled with white stucco, as shown in fig. 48.

In a picture of the Church of S. Maria de L'Antigua at Valladolid, Spain, published in the *American Architect* for December 10, 1887, the typical Spanish tile is shown.

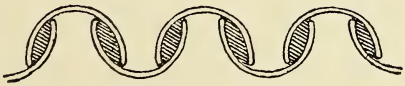


FIG. 48.

The tower of this church seems to be covered with a pointed flat tile.

MEDITERRANEAN BORDERS.

A rapid examination of a collection of photographs of places bordering the Mediterranean, from the Isle of Rhodes to Tangiers, shows the universal use of the normal tile (*imb.*). A picture of the mosque of Tangiers shows a wall, or a house with unperforated wall, having a very steep

pitched-roof covered with somewhat smaller tiles than those cited from Spain. The ridge is covered with the ordinary ridge-tile elevated to a considerable distance above the roof, the interspace apparently filled with white stucco or plaster, giving it an appearance in the photograph, of a high and narrow vertical ridge. The tiles are very unevenly laid, and it will be noticed that in the photographs of Spain, Italy and other countries bordering the Mediterranean, the tiling seems always to have been done in a slovenly manner. This appearance is probably due, in many cases, to the buildings being old and the tiles having being thrown out of alignment by the wind and other agencies. The thorough and accurate way in which the Asiatic roofs are tiled stands out in marked contrast to the loose manner of tiling of western nations using the normal tile.

MEXICO.

I am indebted to Mr. Sylvester Baxter and Mr. Denman W. Ross for photographs and descriptions of the roofing-tiles of this country. Mr. Baxter observed on some roofs a large flat tile either plain or corrugated, the corrugations being quite near together. These were usually coated with a golden-green glaze. Around the City of Mexico and in the high table-lands the flat tile was used. Photographs of buildings at Orizaba, taken by Mr. Ross, show a large tile identical with the Spanish form. Mr. Baxter observed that in some cases the lower tile was painted white on the upper surface, white lead being apparently used, and presumably to make the roof water-tight. He also observed at Cuantla, Morelos, in the tierra caliente, a large flat tile with upturned edges and semi-cylindrical imbrex. A similar form to this has already been described from Central Italy, and, as before remarked, is a survival of the ancient Roman tile. The modern form is much thinner. The tiles bordering the eaves differ in no re-

spect from the others, though the under course of tiles may be laid double.

Chili, Peru and other South American countries have the normal tile (*imb.*) and this runs up on the west coast to California.

BELGIUM AND HOLLAND.

The pan tile is the dominant form in these two countries. That it was also the common form a few hundred years ago is shown in pictures of the old Dutch masters.

In Holland, one may often see roofs thatched half-way down and tiled the rest of the way to the eaves. In the better class of houses in the country the entire roof is tiled. At Utrecht, large, slightly-bent tiles are used for ridge and hip. The pan tile is often made with a square opening in it in which glass is fitted. The tiles are often glazed either red, gray or blue. In Belgium, they appear either black or bright red. On very old churches the normal tile (*imb.*) is seen.

It is interesting to observe that in those portions of Germany, bordering on Holland and Belgium, the German flat tile is supplanted in a measure.

The pan tile, *pannen tegchel*, as it is called in Holland, evidently originated in Holland or Belgium. In England it retains the Dutch name *pannen*, anglicized to pan. It is also called the Fleming tile. In Poland, it is called the Holland tile.

NORWAY, SWEDEN AND DENMARK.

The pan tile is in universal use in these countries. In Norway, away from the larger cities, wooden shingles painted red form the ordinary roof covering. The pan tile is often a bright brick-red in color, or glazed a dark brown. The red-painted wooden roofs would seem to be an imitation of the red tiled roof. In Christiania, an old

house with the date 1662 was covered with pan tiles. In Bergen, the pan tile is commonly seen.

Mr. Ipsen informs me that in Copenhagen the normal tile (*imb.*) is sometimes found on old churches, and is commonly known by the name of monk tile; this name indicating that in Denmark, as in Germany, this form of tile was introduced by the monks from the South.

JAVA.

At Buitenzorg and other towns in the interior of Java a pan tile is seen. The tile is well made, very light and

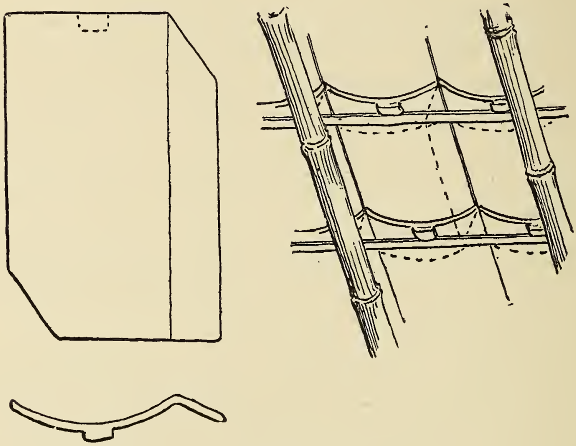


FIG. 49.

thin, and having a length and breadth respectively of 28 centimetres by 18 centimetres. The covering edge is flat, and not curving, as is usual. The upper edge of the tile has a nib which holds it to the battens fixed to bamboo rafters (fig. 49).

I do not recall seeing an eaves tile with turned margins.

There are many Chinese in Java, and their buildings present the type of the Southern Chinese. On these buildings the normal tile (*imb.*) probably occurs, but I made

no note of this matter during my visit there. The pan tile has probably been introduced by the Dutch, or possibly by the English before the Dutch. Fig. 50 is reproduced from a photograph showing the appearance of

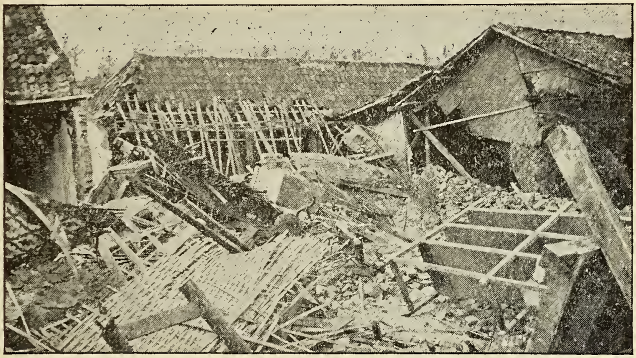


FIG. 50.

Java houses after a shock of earthquake. In this is shown the light structure of the roof supporting the tiles.

GERMANY.

Throughout Germany the flat tile is the common form. When the lower border of this tile is slightly rounded it

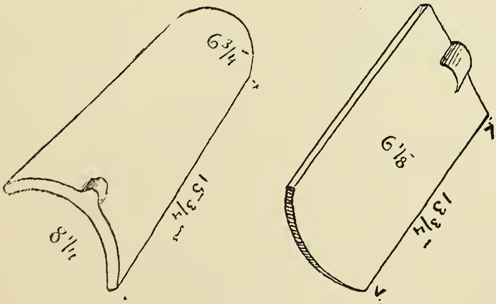


FIG. 51.

is called, in certain portions of the country, "beaver-tail" (fig. 51A). In Berlin the lower border of the tile is

usually rounded (fig. 52), in Weimar it is square at the end, in Nuremberg it is pointed (fig. 53). Occasionally the tiles are laid in a double layer as shown in fig. 54. The flat tile not only extends throughout Germany but runs south to Switzerland, west through France, at least through the central and northern portions, and southeast through Austria to Hungary and Poland, and, probably, northeast to Russia. As one approaches Belgium and Holland, the home of the pan tile, this tile frequently takes the place of the flat tile, as seen at Dusseldorf, Bonn, Cologne, Bremen and Hamburg. This tile is commonly red or glazed black. The pan tile is also occasionally seen farther south. At Freiburg it is known by the name of "Jumping hound," from its fancied resemblance, at the eaves, to the movements of jumping hounds. In the country around Bremen and Hamburg the roofs are often

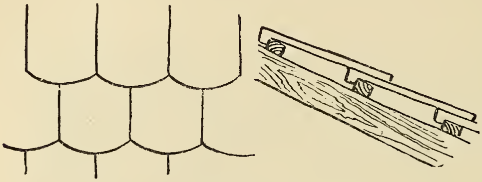


Fig. 52.

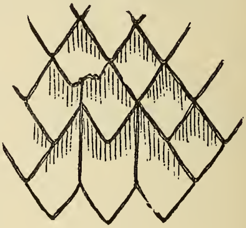


Fig. 53.

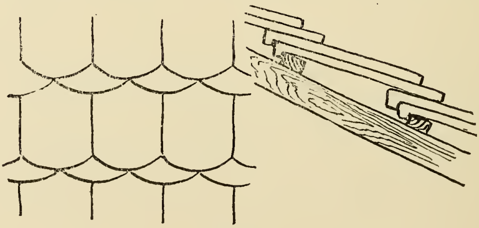


Fig. 54.

thatched, but in these cases a square area about the chimney — which looks odd thrust up through a thatched roof — is covered with pan tiles. In many of these pan-tiled

roofs, the eaves, ridge and ends of the roof are often finished with a few courses of slate, as shown in fig. 55. In Bremen a heavy ridge-tile of the ordinary form is used (fig. 56).

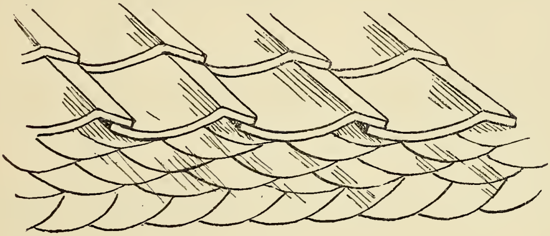


FIG. 55.

In very old buildings throughout Germany, usually on old churches and convents, the normal tile (*imb.*) is often seen. Professor Virchow informed me that this tile was introduced into Germany by monks, from the Rhine, in the twelfth century. As before remarked, this tile is known as the monk tile in Copenhagen.

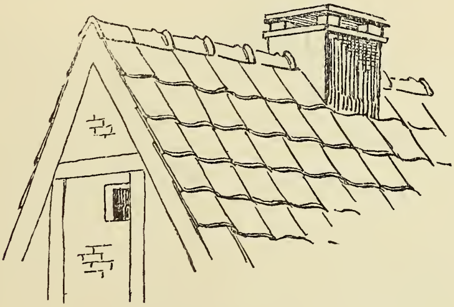


FIG. 56.

The appearance of a flat tiled roof, as seen from within is shown in fig. 57, sketched in the attic of an old house in Nuremberg. Here the manner of propping up a tile with a stick, for the purpose of letting in light is shown; this is done for light and not for ventilation, as the roof is

sufficiently ventilated by the loose adjustment of the tiles. Other means for admitting light to the attic are shown in

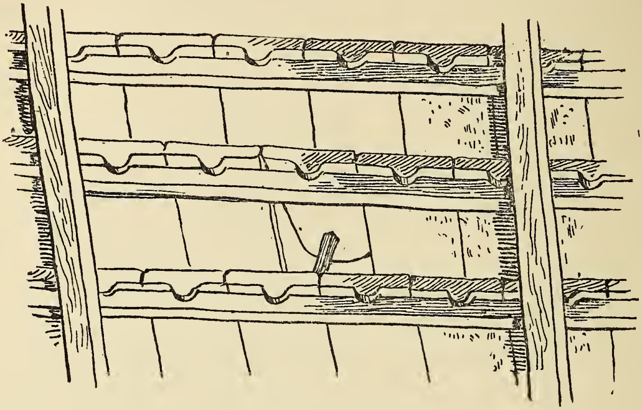


Fig. 57.

fig. 58 (Freiburg) and 59 (Weimar). These hoods or dormer windows are made out of a single piece of terra-

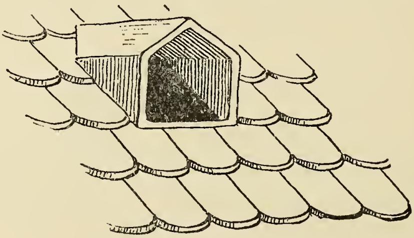


Fig. 58.

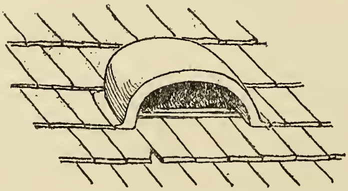


Fig. 59.

cotta; they are secured to the roof by a broad flange around which the tiles are fitted.

Fig. 60 shows the manner of finishing the end of a roof; the battens upon which the tiles are hung project through the wall and the tiles are cut longitudinally to continue the alternate adjustment of tiles to the edge.

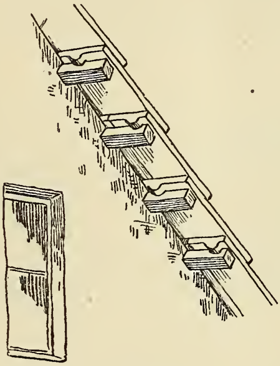


FIG. 60.

At Nuremberg the flat tile is everywhere seen. Fig. 61 is reduced from a photograph of Nuremberg houses showing how deftly the tile is handled in covering dormer

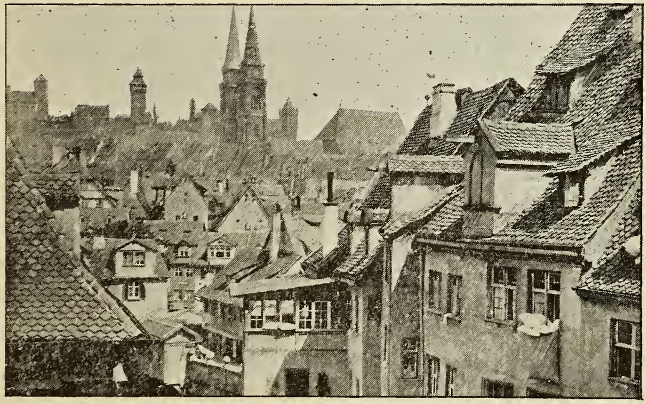


FIG. 61.

windows and various projections. In some cases the lower border of the tile is rounded, in others pointed. Other

forms of tile are seen in this picturesque old city. On the old Roman tower of the castle may be seen a large, thick, coarsely made semi-cylindrical tile, being much larger at the upper end, measuring .51 centimetres in length, and a width at its widest end of .15 centimetres. This tile has a thick nib to hold it to the battens. The

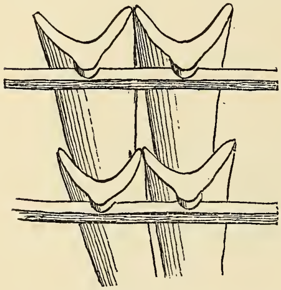


Fig. 62.

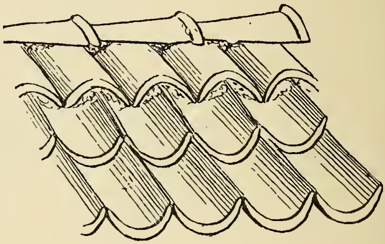


Fig. 63.

spaces between the tiles were thickly plastered though greatly out of repair, as gleams of light were coming through various chinks. Fig. 62 shows the appearance of this tile from within the roof, while the appearance from without is shown in fig. 63. This sketch is taken from the castle wall tower which is supposed to be nearly 400

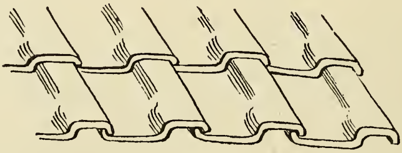


Fig. 64.

years old. The ridge is seen covered with ordinary semi-cylindrical tiles, while a single course of tiles next to the ridge shows the roof-tile used in the form of an imbrex. All the interstices were thickly plastered. The tile was accounted the oldest form used in Nuremberg, and may be regarded as the normal tile. A recent form of tile, which may be looked upon as an extreme modification of

a pan tile, is seen on certain portions of the city wall (fig. 64). At Urfurt (fig. 65) and Wurtzburg (fig. 66) a tile is often seen with a slight ridge turned up on one side, and a recurved edge on the opposite side which laps over the slight ridge on the next tile. This form is certainly a modification of the pan tile, and curiously enough laps

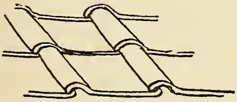


FIG. 65.

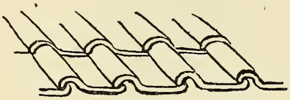


FIG. 66.

to the left, as in the case of the Japanese pan tile. At Hildesheim old houses are covered with a similar form of tile lapping to the left.

POLAND.

I am indebted to Mr. J. Adamowski for information concerning the roofing-tiles of Poland. An architect friend of his, Mr. Kozlowski, of Czenstochowa, writes that the most common form of tile in Poland is the flat tile with rounded end, differing in no respect from the ordinary German tile, and usually laid in a double row, as shown in fig. 54. The dimensions, in English inches, are 7 by 14.

The pan tile lapping to the right is also seen in old buildings and churches. It is no longer made in Poland. This tile is known by the name of Holland tile, and its introduction to Poland may have been by way of the Baltic.

RUSSIA.

An examination of photographs and numerous inquiries show that the tiled roof is not common, but, when seen, it is composed of the flat tile. Dr. Berlin, a Russian physician, and her brother, stated to me that formerly an

angular tile, in form like the ridge-tile, was used as a roofing-tile. These tiles were placed in rows running from the ridge to the eaves, with the crest uppermost, no under tiles being used. The tiles were simply bedded in cows' manure. Repeated questioning failed to modify this statement. It is recorded that in other regions in the east it is customary to plaster the house with manure.

Photographs from the Caucasus show the normal tile (*imb.*) in use.

SWITZERLAND.

The flat tile is everywhere common in Berne, Zurich and other parts of northern Switzerland. In very old houses the normal tile (*imb.*) is occasionally seen (fig. 67), but even in these cases the newer additions to the roof are covered with a flat tile. In some instances the ridge is finished with wood or metal, instead of the usual ridge-tile. The tiles are often seen aligned instead of breaking joint; in this case the roof is first shingled. An elaborate structure of brick, stone and roofing-tile, held together by mortar, forms the top of most of the chimneys, and suggests the idea of a bird-house, or such an affair as a child might build with blocks.

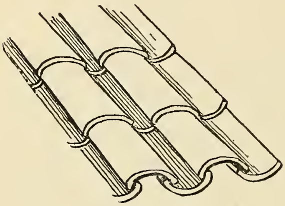


FIG. 67.

They are certainly picturesque and apparently durable, as none of them seem to be dilapidated. Fig. 68 is reproduced from a rough sketch of a few chimney tops in Berne.

At the Historical Museum at Berne, I found an interesting collection of roofing-tiles. I learned that the curator of this department was an architect, and this accounted for the extent of the collection, which was the best one that I saw anywhere in Europe. Among the tiles was one

from the Castle of Trachselwald with the date of 1300 on the label. This was a flat tile with pointed end. It was 34.2 centimetres long and 19 centimetres wide. A rude

FIG. 68.

figure of a bear with rough bars below and above, enclosed in a circular panel, was impressed upon the tile near its

lower end (fig. 69). Another flat tile, also pointed at the lower end, had two many-rayed stars impressed upon it. The date 1666 had been incised with a small point across the middle of the tile, and at the square end the same date had been marked with the finger (fig. 70). This tile was

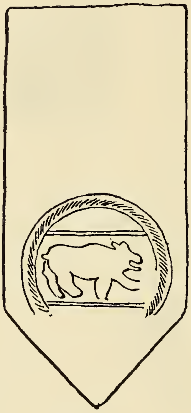


Fig. 69.

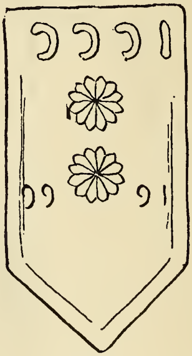


Fig. 70.

36.8 centimetres long and 19.3 centimetres wide. In this collection was a curious glazed tile, evidently made for the top of a stove, but representing a sloping roof. This had alternate squares of brown and straw-colored glaze, representing the pointed flat tile. Its date was supposed to be

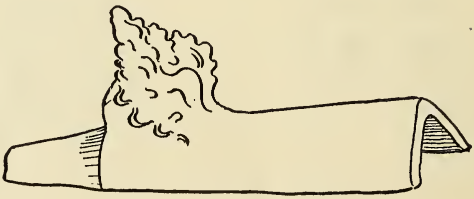


Fig. 71.

1300. In the collection were also ridge-tiles with foliated ornament (fig. 71). These were green glazed, and labelled Castle Thurgau, Canton of Thurgau, city of Arbou. The specimen figured was 37 centimetres in length.

At the Antiquarian Museum at Zurich were preserved a few old flat tiles (fig. 72). These far exceeded the dimensions of the other flat tiles described, one specimen measuring 46.8 centimetres in length and 17.2 centimetres in breadth. The nib was large and broad, and the lower end of the tile was roundly pointed. Another specimen of the same length, and having a breadth of 23.5 centimetres, was pointed, the pointed end being cut off square. The lower exposed portion was coated with salt glaze; the nib was small and recurved. These tiles were about 350 years old.

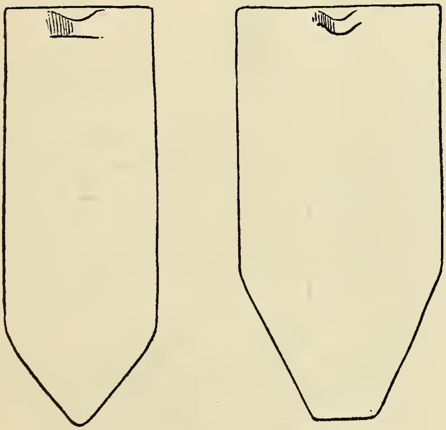


FIG. 72.

At Basle the buildings were somewhat mongrel in their appearance, partially losing their Swiss character without assuming their German character. The tiles were flat with rounded ends. On the old cathedral in this town the tiles were glazed green, red and white and in the rebuilding of certain portions of the cathedral new flat tiles, glazed the same colors, were being used, the bright glaze of even the old tiles forming a startling and disagreeable contrast to the time-stained stone and other material of the structure. Some interesting ridge-tiles with green and brown glazes

were found in a local museum. These had Gothic scrolls and leaves springing from their crests; in one case the finial was held to the tile by an iron rod, as a dowel. (The height of this tile was .67 centimetres.) These

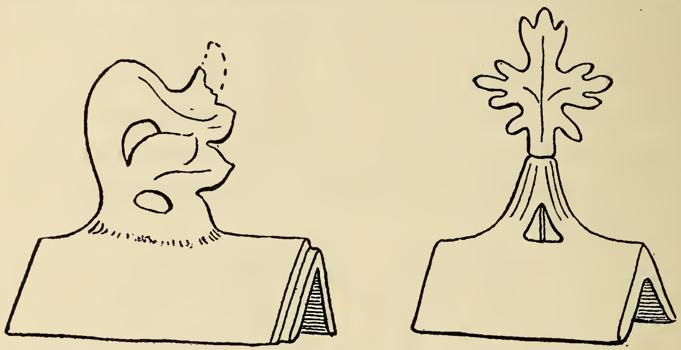


FIG. 73.

tiles were labelled Nicholas Chapel, fifteenth century (fig. 73). At Interlachen, the flat tile was seen on some of the older buildings, the modern structure being roofed with modern forms of tiles, which seemed to have certain merits in securing a tight roof (figs. 74 and 75).[1]

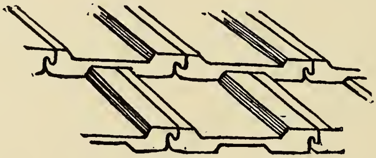


FIG. 74.

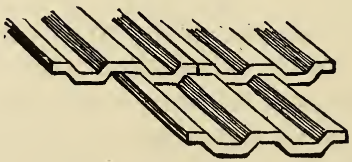


FIG. 75.

[1] A modern interlocking tile is made at Allkirch village, Canton of Berne, by Gilardoni Brothers. I found it on many houses at Berne, and, if I remember rightly, it was the tile used on the new arsenal at Berne.

The new arsenal at Berne had a tiled roof resting on battens, each tile so loose that it could be easily pushed up from within. There was no sheathing beneath, and here and there glints of light could be seen. Indeed, it was blowing a gale and snowing at the time I was there, and a little snow had blown in. That the roof was waterproof was implied by the fact that a new building filled with polished weapons had only this kind of a roof-covering for protection. From the behavior of certain tiled roofs in our country, we have certainly not yet learned the seciet of a good tile.

FRANCE.

My information concerning French roofing-tiles is very meagre, being chiefly based on hasty notes made in Paris and vicinity, and observations from the main railways from Paris to Brussels and Calais respectively, supplemented by the examination of a few photographs.

The flat tile appears to be the dominant form throughout central and northern France, while the normal tile (*imb.*) is common farther south, and especially along the Mediterranean. The flat tile is usually square at its lower end and smaller than the German or Swiss form. At the Paris Exposition many forms of roofing-tiles were exhibited from French tileries, among which were large numbers of flat tiles.

The introduction of roofing-tiles among the peasantry must have been comparatively recent. Leslie (*Essays on Moral and Political Philosophy*), writing of Puy-de-Dôme, a central department of France, says : "I saw many instances of a change which is the precursor of an elevation of the standard of habitation, namely, the substitution of tile for thatch roof." In Spenser's Sociological Tables a number of references are conveniently accessible concern-

ing the roofing material in France in early centuries. Vitruvius, the famous Roman architect, in the first century of our era says: "The Gauls to this day build their houses of boughs, reeds and mud, with roofing of oaken shingles or of straw. Even at Massalia we may observe roofs made without tiles, of earth kneaded, as it were, with straw." "It appears from Orderic's narrative (1090 A. D.) that the roof of the castle was covered with shingles of wood instead of slates or tiles. This is still the case with respect to many of the towers of the country churches in the Lieuvin and the Roumois."

"The working of plaster quarries, the use of tiles for roofing houses and afterwards the discovery of slate . . . entirely changed the appearance of houses. It was only in the fifteenth century that slate was used. In 1465 it was just begun to be known of." (Chérul, *Dictionary of Institutions, Manners and Customs of France.*)

GREAT BRITAIN.

In England two kinds of roofing-tiles are in use: the flat tile, which is the form most commonly seen, and the pan tile, which is found widely distributed. This tile is also known as the Flemish tile, this name implying that it was first introduced from Flanders.

The cheapness and excellent quality of slate and its almost universal use have evidently checked the development of the roofing-tile. One sees no attempt at architectural effect in the treatment of the roof, but the tiling is done in that durable manner which characterizes English work in general. The head of the pan tile has two nibs instead of the usual single one, and the tiles are adjusted with greater care to the roof.

In the collection of building material at the South Kensington Museum may be seen a great variety of roofing-

tiles. In the catalogue of this material, published by this museum in 1876, these roofing-tiles are variously recorded as plain tiles, red, green and brown; plain tiles colored to match old tiling; terra metallic; single, double and treble channelled tiles; flat or Roman ornamental roofing-tiles; ridge-tiles with ornamental crests, and many others. As most of these tiles are modern productions (many of them the result of England's awakening which followed the World's Fair of 1851, and the renewed impulse of the French Exposition of 1855), their consideration does not properly come within the scope of this paper. One tile, however, figured in the catalogue above referred to, appears interesting as well as serviceable (fig. 76). It is a French tile known as the tile Courtois, from the name of its inventor. It seems to have the merit of simplicity and but little of the tile is concealed in the lap. In 1856–57, this tile was made at Stamford, England, and used on a number of buildings. In 1876, a tile somewhat similar to this was made near Hull. Many of the tiles mentioned in the catalogue failed to come into general use. An example of the treble channelled tile I saw at Cambridge, England, and, curiously enough, at Stockholm. This tile might be regarded as a variety of the pan tile with three equidistant folds, the side lap being made as in the pan tile.

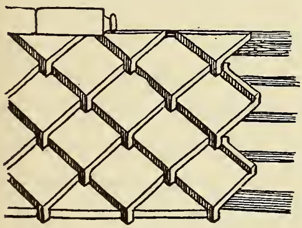


FIG. 76.

From various sources one may gather a continuous history of the introduction and successive appearances of the various forms of roofing-tiles in England. The early British houses were circular, with low stone walls and conical shingle roofs. With such a form of roof the use of terra-cotta roofing-tiles was well nigh impossible, and a square

house with the ordinary sloping roof must have preceded the use of roofing-tiles.

Before the introduction of pottery tiles, rough stones were used for roof coverings. "In localities which supplied laminated stones such as Gloucestershire and Hampshire in Britain, the Romans often roofed their buildings with stone tiles fastened on with iron nails" (see tiles, *Encyclopædia Britannica*). Lieutenant-general Pitt-Rivers in a communication on an ancient British settlement excavated near Rushmore, Salisbury (*Journal Anthropological Institute*, Vol. XVII, p. 190), records that "tiles of Purbeck shale, with nail-holes to fasten them by, were also found more frequently in the rich quarter than elsewhere and terra-cotta tegulæ were also found there, but only in fragments and used as pavements, for which purpose these tiles were frequently employed elsewhere. The absence of imbrices which are a necessary adjunct in the formation of a Roman tiled roof confirms the opinion that the roofs of the Romano-British village were not tiled in this way. Although the fragments of the tiles show that they had certainly been originally constructed for roofing, their use for a second-hand purpose conveys the impression of poverty, although too much stress must not be laid upon the circumstances."

It would be interesting to ascertain whether any fragments of these tegulæ had traces of cement upon them, for we have seen that in Japan, the tegulæ well bedded in clay or pointed with mortar may be used without imbrices.

It was customary in the Middle Ages and up to within recent centuries to use rough-stone tiling. At Broadway, near Worcester, England, one may see a village in which many of the cottage roofs are tiled with small flat stones of the roughest description. These are held to the roof by oaken pins which suspend them on the battens placed

across the rafters for the purpose. Fig. 77 shows the appearance of one of these cottage roofs and the manner in which even the small roofs of dormer windows and hips may be neatly covered by this rough material.

Fig. 78 shows the appearance of a portion of the roof from within. The stone tile (fig. 79) used for this purpose measures, roughly, .22 centimetres in length by .14 centimetres in breadth, with a general thickness of .02 centimetres. It is made of some fossiliferous limestone. I learned that these houses were over three hundred years

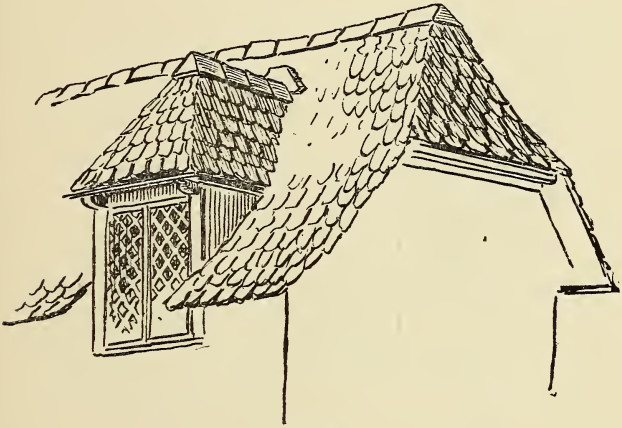


FIG. 77.

old. I also observed on one of the oldest houses in Oxford similar rough-stone tiles, and doubtless, they occur in many other places.

Mr. Ross Turner informs me that in Bermuda a rough, flat tile is cut from the coral sandstone rock, and cedar pins are used to hold the tiles to the roof after the manner of the rough, stone tile just described. An old house at St. Georges, over two-hundred years old, and St. Peter's Church, St. Georges (1630–40) were covered with this tile and they are in use to-day.

In an interesting work by Thomas Wright on the *Homes of Other Days*, many reproductions of old drawings of Saxon and Norman times are given, from which some hints of the kinds of roofing tiles in use may be found. From the Harleian MS. dating from the ninth century, a picture is given of an Anglo-Saxon house ; in this picture a variety of roofing-tiles are shown, the most conspicuous of which is the normal tile. The flat Roman tile is also given, and another form resembling round-ended flat tiles, though these may be wooden shingles. Flat Roman tiles again

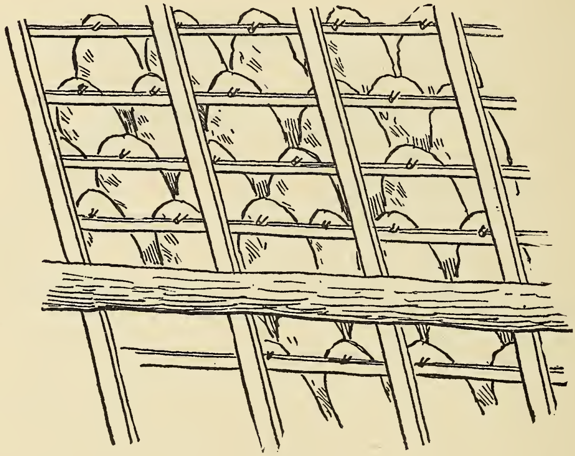


FIG. 78.

appear in another drawing of the tenth century, and in another picture of this epoch the flat tile, with round end, and the normal tile are represented. A picture of a town of the tenth century shows only the normal tile. In an Anglo-Saxon MS. of the Psalms, the normal tile is indicated, and what appears to be an imbricated ridge of tiles. In a roof shown in the Bayeux tapestry, the normal tile is seen. In an early Saxon illumination, a large normal tile is shown. In early Norman times, the normal tile is de-

picted in the drawings. In all the above cases the normal tile (*imb.*) is the one indicated. A complete view of a house is shown in a MS. of the fourteenth century, and this represents the flat tile rounded at its lower end. In the same MS. flat tiles are shown arranged in a form often seen in the arrangement of slates in England to-day, where an interspace of an inch or more is left between contiguous slates in an horizontal line. From this time on, the flat tile is the only one shown in the various drawings given. It would seem by this that the pan tile was introduced from Belgium within recent centuries.

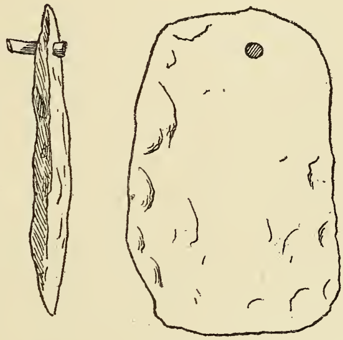


FIG. 79.

In consequence of the frequency of fires it was enacted in the first year of Richard I (1189) that the lower story of all houses in the City of London should be built with stone and the roofs covered with slate or tile (*Pictorial History of England*, Vol. II, p. 230). In the fourteenth century, London houses were generally roofed with tiles.

" In taking down part of a late Norman building in Southwark some years ago, to make the approaches to the present London bridge, some tiles were found built into the wall and may have formed part of the original structure. They were thirteen inches by eight inches and varied in

thickness from five-eighths of an inch to an inch. Half of one side, which would have been exposed upon a roof, was glazed, and they were made with pin-holes in them, as is still the custom in some districts." (*Glossary of Architecture*, Vol. I, p. 463). In the work above cited it is stated that, in the fourteenth century, "the manufacture of tile was one of sufficient importance in England to require regulation by statute . . . whereby the dimensions of plain tile are fixed at ten by six and one-fourth and half an inch and half-quarter thick, at least. Roof or crese tile at thirteen inches long, thickness same as other." Also that, in the Middle Ages, tiles were extensively employed in covering buildings though they seem always to have been considered an inferior material to lead. In the same work are given some remarkable ridge-tiles with figures, crosses, etc., modelled upon them. These were found at Great Malvern and London; the statement is also made that flat tiles only were used at that time.

From the above data, we venture to suggest the following historical sequence in the introduction of the various forms of roofing-tiles into Great Britain: First, the large flat Roman tile and the same time the rude stone tile probably devised by the Romans while in England. Second, the normal tile, probably introduced by monks. Third, the flat tile introduced from Normandy, and, finally, the pan tile introduced from Belgium.

The flat tile is not only used for roofing but is also used in finishing the vertical walls of a gable end. In this case the tiles may be cut pointed, or otherwise shaped, as in fig. 80. Dobson's hand-book of *Tiles and Tile-making* says that pan tiles were formerly made with holes in them for the reception of the tile-pins by which they were hung on the laths. The common method now is to turn down a couple of nibs at the head of the tile, which answers

the same purpose. The roofing-tile is used for other purposes besides that for which it was originally designed. In flower-gardens the flat, round-ended tile is found very serviceable in separating beds or bordering paths, the tiles being partially buried in the ground vertically, forming a much better dividing line than do strips of board, which soon decay. As a coping for brick walls the roof-shaped ridge-tile forms a good and picturesque top. The same form of ridge-tile placed in an inverted position may often be seen on the steep slopes of grass-covered railroad enbankments, as cheap and useful water-conductors.

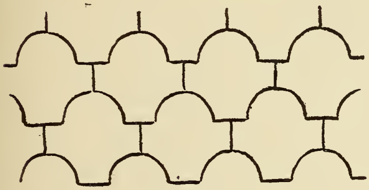


FIG. 80.

UNITED STATES.

We have seen in the course of this paper that in all parts of the world, outside of savage areas and under all climatic conditions, people shelter themselves beneath roofs covered with terra-cotta tiles. With this wide dispersion of roofing-tiles, however, there still remains a territory extending from the Atlantic to the Pacific, embracing Canada and the United States, which is virtually destitute of this ancient form of roof-covering. It is a curious fact that a material so cheap, durable and picturesque, and one so widely distributed throughout the world, should not have effected a lodgment in this country. It seems all the more singular when it is considered that the early colonists —Spanish, Dutch, French, English, German—all came from tile-using countries. This curious condition of things can only be accounted for by the fact that, at the outset, wood was so much cheaper than any kind of baked clay that it was used in the form of clapboards and shingles to

the exclusion of other material, and thus the habit finally became ingrained.

That early attempts were made to use tiles in this country is attested by Mr. F. A. Barber, in his interesting article on the "Rise of the Pottery Industry in the United States" (*Popular Science Monthly*, December, 1891). In this article he shows that the flat roofing-tile was used in Lancaster County, Pennsylvania, as early as 1769, as tiles bearing the date scratched upon them have recently been discovered there. I am indebted to Mr. Barber for the following cut of this tile (fig. 81). As the form of this

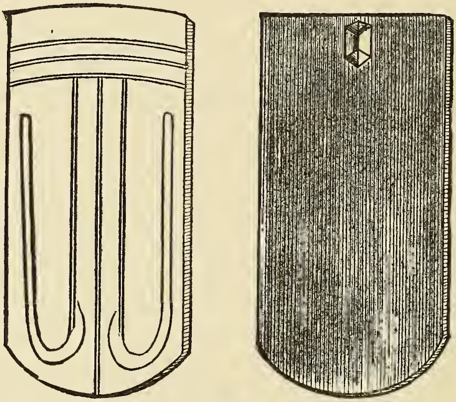


FIG. 81.

tile and its dimensions correspond to the average flat tile seen in Germany, it is almost certain that the tile was introduced by the early German emigrants to that region. I am also indebted to Dr. Charles C. Abbott, of the University of Pennsylvania, for information regarding some pan tiles discovered by him on Burlington Island, Delaware River, New Jersey. These tiles were found associated with rudely made red and yellow brick, on the site of a house built by the Dutch in 1668, and shortly afterwards destroyed by the Indians. The outline of the specimen

sent me by Dr. Abbott shows the typical Dutch pan tile of the roughest description.

Within recent years, pan tiles and flat tiles have been manufactured and used in this country. Their use has been mainly confined to large structures, not for the sake of economy or utility, but for architectural effect. Such roofs have been far more expensive than similar ones in Europe, and judging from the trouble many of these roofs have given, it is quite evident either that the right kind of tile has not been made, or that it has not been properly applied to the roof. From the frequent breaking of the tiles, it has been supposed that our climate, with its rigorous changes, was the cause of this. I have observed, however, in Europe, that tiled roofs are quite as common in regions north of the line of frost and snow as below that line. In England, the effect of frost is spoken of as being unfavorable to tiled roofs. Despite these drawbacks, it would seem that the terra-cotta tile, when properly made and adjusted, is one of the cheapest and most durable of roof-coverings, as it is certainly one of the oldest and most widely distributed.

Acting as a non-conductor, the upper portion of the house is warmer in winter and cooler in summer. Slate roofs absorb and transmit a good deal of heat. Shingle roofs are a menace in times of conflagration. With the best tile clays in the world and an abundance of the rude labor usually employed in tile-making, there is no reason why roofing-tiles should not come into common use in this country, as they have in all other parts of the world.

INTERLOCKING TILE.

At the present day there are a great many forms of tiles made in Europe, especially in France and Switzerland, some of which are very ingenious. The object to be at-

tained in an interlocking tile is to devise a form which shall, by a series of ribs and corresponding depressions, more thoroughly exclude water. In the United States, tiles of this kind are being made besides the ordinary pan and flat tile. It is not within the purposes of this paper to speak of these in detail, as there are many kinds each possessing certain merits.

I cannot forbear, however, alluding to a remarkable exhibition of this material at the late Paris Exhibition which suggested what an extraordinary industry might spring up in this country if the merits of terra-cotta roofing-tiles could be made more widely known. In this exhibition there were not only a great many displays of the ordinary flat tiles, but there were pan tiles as well as interlocking tiles made of pressed glass, by the use of which dark warehouses and attics might be made light. The tiles were made precisely like the terra-cotta ones, so that here and there they could be introduced thus letting in gleams of light in usually dark places, or the entire roof might be covered with these glass tiles. There were also terra-cotta tiles perforated to admit little squares of glass. Graeber has called attention to ancient Greek tiles in the temples at Phigalia, Athens, and other places, in which the large flat terra-cotta tile was perforated for the purpose, as he believes, of admitting light in dark places under the roof.

TILE-MAKING.

In the course of this paper it has been shown that throughout the world with the exception of our country and Canada the use of terra-cotta roofing tiles is universal. There is no reason why they should not come into general use in this country. There are large regions in the United States, like Arizona, New Mexico and certain

western states and territories where forests are scarce or altogether absent, yet having an abundant supply of coal suitable for the baking of tiles, and the best clays in the world. With the rapid destruction of our forests and the consequent increase in the price of wood, shingles and clapboards, the tile-making industry should spring up in many parts of the country.

A few brief notes, concerning the making of tiles, are here appended to call attention to the simple appliances and the rude character of the labor employed in the manufacture, in the hopes of encouraging the industry. If we have brick-kilns everywhere we should be able to sustain tileries also.

Edward Dobson's *Hand-book on Bricks and Tiles* in Weale's series, gives illustrations of the various machines used in the making of flat and pan tiles. From this we learn that in Staffordshire a workman may produce 1,300 to 1,500 flat tiles in a day. In Gwilt's *Encyclopedia of Architecture*, it is stated that "clay from which tiles are made will make good bricks—the converse does not hold good, it requires tough clay to make tiles, on account of the thinness of the tiles. Much care is required in baking; if the fire be too slack, they will not burn sufficiently hard, and if too violent they glaze and suffer in form."

It is observed also that glazed tiles are not so much affected by frost. In Europe, as in Japan, old tiles are considered better than new ones. We learn from the same authority that an ancient custom was to bed tiles in hay or moss. When the roof is full pitch, this suffices without mortar; with less pitch, mortar is used to point the tiles in order to keep out snow or rain in a high wind. We have seen that in Japan and Korea, and probably in China, also, mud or clay is used in which to bed the tile, and in these as well as in all other countries mortar is used in

various ways to point the tiles, particularly at the eaves and ridge.

In Germany, the making of flat tiles, as I saw it near Wurtzburg, was of the simplest description. An iron frame having the outline of the tile to be made was the only important implement involved in the process. This frame represented the mould. The table upon which this rested consisted of a thick piece of plank, over which was spread a piece of woollen cloth, one edge of which was nailed to the lateral edge of the plank, while the opposite edge of the cloth had secured to it an iron rod, the weight of which kept the cloth drawn smoothly over the plank. The iron frame was now placed upon the cloth (fig. 82)

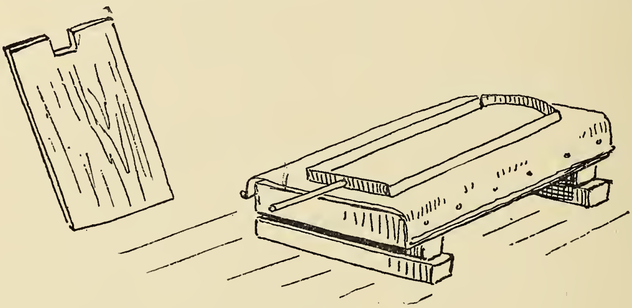


FIG. 82.

and clay was packed into it with the hands, and then pounded down with a wooden mallet such as a moulder might use. A straight-edge was used to scrape away the superfluous clay, a little mass being left at the head of the tile which was afterwards shaped into the nib which was to hold the tiles to the laths or battens. This being done, a square piece of board notched at one end to admit the nib was placed on the frame. The workman then grasped the iron rod attached to the free end of the cloth and, with the other hand holding the board in its place, lifted the cloth and inverted the whole thing, transferring the soft tile to the

board.[1] The iron frame was then removed, and the board with its unbaked tile was placed in the sun to dry. The workman informed me that he could make a thousand tiles a day. Fig. 82 shows the iron frame resting on the flannel in position to be filled with clay. The board upon which the unbaked tile is to be transferred is to be seen to the left. Fig. 83 is reproduced from a hasty sketch of a Wurtzburg tiler at work.

Large dome-shaped brick ovens were used in baking

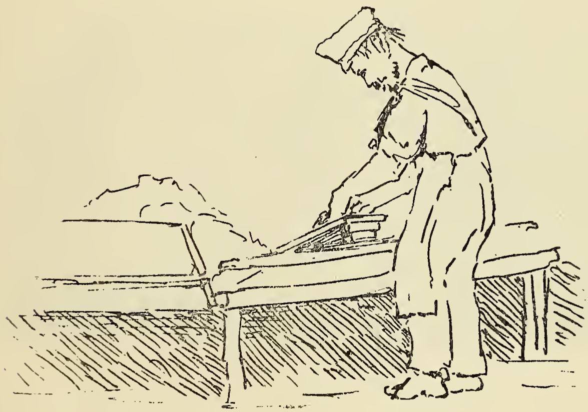


FIG. 83.

the tiles. The structure was flat above, and leading down to the ovens below were small holes two or three feet apart. The fire, having been started, was afterwards fed by pushing into these holes at short intervals small quantities of fine coal or coal-dust. The utilization of coal-dust in this way struck me as an economical method of using this waste product. I was informed that ordinary bricks were baked in the same way.

[1]Many old Korean and Japanese roofing-tiles show on their lower side a cloth-mark impression, and doubtless similar methods were resorted to in their manufacture.

Mr. Howard Walker informed me that in France he had seen a tiler at work first shaping a flat piece of clay into the proper dimensions and then bending it over the upper part of his leg, at the same time pushing up a nib of clay at the head of the tile with his thumb.

In Japan the tiles are made in moulds, dried in the sun, and baked with pine fagots and twigs for fuel. Fig. 84 represents the appearance of a Japanese tilery near Tokio.

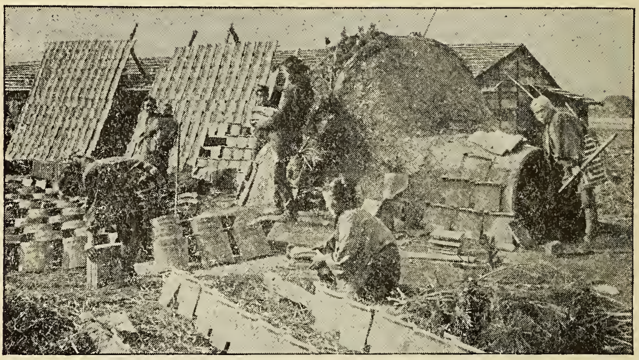


FIG. 84.

SUMMARY AND CONCLUDING REMARKS.

The older roofing-tiles of the world group themselves into three distinct types, the normal or Asiatic tile, the pan or Belgic tile, which is an outgrowth of the normal tile, and the flat or Germanic tile, which is an independent form. The normal tile, the earliest known form, covers by far the greater number of roofs to-day. With few exceptions it is the only form of tile used in Asia, Asia Minor, Greece, Italy, Sicily, Spain, the countries bordering the southern shores of the Mediterranean, and all the Spanish and Portuguese colonies and countries in both hemispheres. This tile is also found in areas contiguous to the countries above mentioned.

The treatment of the roof covered with this tile in the Orient and in the Occident differs widely. In China, Korea, Japan, and countries to the south of China the ridges are usually conspicuous for their elaborate structure. The tiles are aligned with great care, the eaves tiles have turned margins of graceful outline with ornamental designs upon them in relief. The roofs of the more important buildings have their ridges, hips and eaves in strongly curved lines and with this treatment the curved tegula is in harmony. In the Occident, one sees but little attempt at architectural effect in the treatment of the tile. The ridge is rarely more than a single course of semi-cylindrical tiles, though in certain Swiss and English glazed ridge tiles of a few centuries ago finials were moulded upon them. The eaves tiles differ in no respect from those of the roof and the only attempt at decoration was by the introduction of stucco or white plaster between the courses, as occasionally seen in modern Grecian houses and mediæval Spanish ones. In ancient Greece the ridge and eaves tiles, the huge discs terminating the ridges, the antifixæ, etc., decorated in polychrome, added greatly to the beauty of the roofs.

The discovery by Graeber, on the site of the earliest example of Greek architecture, of a fully developed normal tile with curved tegula, and disc-closed imbrex, identical with that of eastern Asia, compels one to believe that from the far East came the roofing-tile. The curved tegula would naturally harmonize with the curved lines of the Eastern roof, while a straight-edged tile would be more in accordance with the straight lines of the Greek roof, and as a matter-of-fact, we find the curved tegula soon yielding to the broad flat tegula, which ever after became the dominant form for the monumental buildings of ancient Greece, Italy, Sicily and Etruria.

Successive invasions of the Asiatic tile, in a measure, supplanted the normal flat type which seemed at the outset to be associated with monumental buildings, though this purely classic form has survived in the modern flat type seen in Italy to-day. The circular disc closing the imbrex points distinctly to eastern Asia, and the subsequent decoration of the eaves and ridge tiles, while strongly suggesting an Eastern origin, is no sure criterion, as to whatever the Greeks touched they imparted a charm derived from their own matchless instinct for the beautiful.

It seems curious to see the antifixæ attached to the eaves tiles, at Assos, as late as the Roman epoch, and yet 600 years before, at Selinus, these elements had already become detached from the roofing-tiles and were independent pieces, nailed to the top of the stone coping.

The historical sequence in the development of the early Grecian, Etruscan, Roman and Sicilian tile, and the source of the first form—the *norm* as Graeber describes it—so common in China to-day, must ultimately be cleared up. The material is indestructible and the character of a fragment, even, is easily recognized.

It has been impossible to find data indicating, even approximately, the first appearance of the pan tile and the flat tile, though it is probable that these data exist.

The geographical distribution of these three types of tile to-day is a matter easily ascertained and I venture to present the following map of Europe (fig. 85) upon which are indicated by conventional lines the regions where these various forms occur. These lines represent the appearances of the tiles in section and will be readily understood. The single curved lines represent the normal tile, the lines of double flexure the pan tile, and the short, straight lines the flat tile.

As the normal tile is almost universally distributed in

Asia, it was unnecessary to represent that region of the world.

Sources of information.—The preceding notes have been derived from personal observation in most of the countries mentioned, except in India and Persia and those countries immediately bordering on the Mediterranean. For these countries, particularly Italy and Greece, I have depended upon photographs. Many of these examined were of large size, and presented the most reliable details; even when of small

FIG. 85.

size, the type of tile could be easily made out with the aid of a lens. Reproductions from sketches illustrating architectural tours, etc., could not be depended upon, as the roofs in these drawings were usually represented by rough, shaded surfaces or formal lines. The art-galleries in Berlin, Dresden, London and other places were good hunting-grounds to fix the date of the use and distribution of the roofing tiles (as, for example, a picture by Botticelli in the Dresden Gallery, of the thirteenth century, showing the flat, normal tile of Rome;

a picture of the Sienese school, twelfth century, in the National Gallery, London, showed a similar tile. The old Dutch masters present the pan-tile, and Teniers shows the angular ridge-tile on a thatched roof).

Collections of photographs, however, furnish the best material when one cannot visit the country; the only drawback is that such pictures usually present monumental buildings, often roofed with metal, and it is only by chance that the roof or ridge of some common house comes into the picture. For the photographic and other material I am greatly indebted to the collections of the Boston Museum of Fine Arts, Peabody Academy of Science, Salem, Gen. Charles G. Loring, Mrs. Helen Abbott Michael, Mr. and Mrs. E. F. Waters, Mr. T. F. Hunt, Mr. Sylvester Baxter, Mr. Denman W. Ross, Mr. J. Adamowski, Mr. A. E. Barber, Prof. C. C. Abbott, Mr. Alban Andrén, Mr. G. E. Walters and others, whose names are mentioned in the text. My obligations are especially due to Mr. Edward Robinson for calling my attention to numerous memoirs on the Classical antiquities of Greece and for the use of his valuable Classical library.

BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 24. Salem: April, May, June, 1892. Nos. 4, 5, 6.

THE REPTILES OF THE GALAPAGOS ISLANDS.

From the Collections of Dr. Geo. Baur.

BY S. GARMAN.

Chelonia, Sauria and Ophidia have been discovered on the Galapagos. Excluding the marine forms that may from time to time be found on the shores, only four families are represented: the Testudinidæ of the tortoises, the Iguanidæ and the Geckonidæ of the lizards, and the Colubridæ of the snakes. Neither is peculiar to the locality. The sea tortoises of the Chelonidæ are known to visit the beaches, and stragglers of the Sphargidæ may also be expected to wander there. Certain of the sea snakes, Pelamis, of the Hydrophidæ, frequent the waters nearer the continent and may at times be captured among these islands.

Two genera of the lizards, Conolophus and Amblyrhynchus, are found only on the Galapagos; their closest allies, however, are inhabitants of the western coasts of South

America. The other five, Testudo, Tropidurus, Phyllodactylus, Gonatodes, and Orophis, are genera of which very closely allied species are distributed along the same coasts.

Only one of the species discovered on the islands, *Phyllodactylus tuberculosus*, has not been distinguished from those of the continent. It ranges from Chile to California. The tubercles of Dr. Baur's specimen differ so much from those of the mainland form that the type may prove to be a new variety if not a distinct species. The balance of the species, though in cases but little differentiated, are sufficiently distinct for recognition among their continental allies.

The affinities and the amount of differentiation of the species on the various islands prove beyond question that the insular genera and species were derived from those of the nearest South American coasts, either somewhat directly and recently or more remotely, from common ancestors. While there is a general agreement in regard to the sources from which the different forms of plants and animals at present inhabiting the islands were primarily derived, the agreement is not extended to the manner of derivation. Advocates of the theory of independent, volcanic, origin of the archipelago claim that accidental introductions have established the flora and fauna, and explain the varying affinities of the types by asserting the transportation of the same or of different species to particular islands and by the effects of isolation and varied surroundings. They do not consider the six hundred miles or more of distance from the source of supply to be an insurmountable obstacle, and they are favored by the great Peruvian current and by the winds. Advocates of another theory hold that the islands once were mountains connected with what is now the continent by lower lands, that by subsi-

dence they became separated, and that the modern forms of life, with exception, perhaps, of one or a few of recent introduction, are simply the descendants of continental forms established in their present localities before the connecting lowlands disappeared in the ocean. In both theories, isolation and differences of circumstances were the important factors in differentiation; and the closeness of existing relationships may be cited in favor of each of the hypotheses.

The portion of the collection submitted to me for examination suffices for special determinations but is insufficient for purposes of generalization. It indicates that a most important contribution to the scientific history of the region might be made by one who is able to gather from each of the islands series large enough to supply the now-lacking means for comparisons. His most extensive series, that of Tropidurus, and the tortoises have already been studied by the Doctor himself. Among those identified in this paper his collection has added one genus, Gonatodes, and two new species, *Gonatodes collaris* and *Phyllodactylus Baurii*, to the list of those reported from these localities.

One of the most interesting specimens in the collection is a small Conolophus from Barrington. It is important because of the opportunity it affords for a description of the young, and because of the light it throws on the derivation of the genus. Its resemblance to forms of Enyalioides is so great that if larger individuals were unknown we should place it in that genus by the side of *E. laticeps*, as a closely allied species. A comparison of this specimen with others of species of Enyalioides makes it very evident that Conolophus was derived from one of their immediate ancestors, the nearest, perhaps, that of *E. laticeps*. Conolophus and Amblyrhynchus have close anatomi-

cal affinities, and they must have come from nearly allied forms, not from the same form. It may be that both of these genera developed on the same island, the arid belt near the shores evolving the cactus-eating Conolophus while Amblyrhynchus made its food of seaweeds. Or it may have been that Amblyrhynchus developed on one or more of the islands on which there was no alternative for the seaweed, whence the lizard has reached other localities in which it now occurs. How these saurians became possessed of the vegetarian habit is a question to which our only answer is conjecture. Its inheritance from herbivorous mesozoic progenitors that might have existed is not to be seriously considered. While it may have been the case that allied species on the mainland also to some extent fed on plants, it is more likely that scarcity of animal food rather suddenly brought upon them, whether through emigration or otherwise, compelled a change of diet. Such achange would be complete in a single generation; whereas more gradual diminution in the supply of animals might induce or permit adaptation, by reduction in size or needs, to correspond with the conditions. Conolophus with its feeding habits could only develop in such places as now harbor it, the higher of the islands, those surrounded by the cactus-bearing arid belt and possessing the fertile upper plateaus. By this fact it is restricted to a few of the islands. But Amblyrhynchus is equally at home on any of the islands with sufficient shoal water around them for the production of the seaweeds. It may have started on one of the islands that have no fertile upper belts, which are not high enough to arrest the moisture needed for vegetation. However it reached such a territory it would be obliged to depend on the beaches for subsistence, and from such a place it might spread over the entire archipelago.

The determinations Dr. Baur has reached in his studies of the genera Testudo and Tropidurus are the following:

TESTUDO.

T. ELEPHANTOPUS Harl.	(*T. vicina* Gthr.)	Probably James.
T. MICROPHYES Gthr.		Albemarle.
T. ABINGDONII Gthr.	(*T. ephippium* Gthr.)	Abingdon.
T. GALAPAGOENSIS Baur.	(*T. elephantopus* Jack.)	Charles.
T. NIGRITA Dum. Bibr.		Locality unknown.
T. GÜNTHERI Baur.	(*T. elephantopus* Gthr.)	Locality unknown.

TROPIDURUS.

T. GRAYI Bell.		Charles.
T. BIVITTATUS Pet.	(*T. lemniscatus* Cope.)	Chatham.
T. INDEFATIGABILIS Baur.		James & Indefatigable.
T. DELANONIS Baur.		Hood & Gardner.
T. DUNCANENSIS Baur.		Duncan.
T. ALBEMARLENSIS Baur.		Albemarle.
T. PACIFICUS Steind.		Abingdon.
T. HABELII St.		Bindloe.

In connection with this genus I may add an interesting note obtained from Count L. F. de Pourtalés in a conversation after his visit to the Galapagos on the Hassler Expedition. He stated that one day as he was sitting on a rock on the shore of one of the islands he saw a hawk stoop for one of these little lizards running back and forth on the sands. At once on the approach of his enemy the lizard rushed into the water and remained there until the hawk had gone away. So far as I am aware no notice has heretofore been made of a disposition on the part of species of Tropidurus to enter the water.

Below are given the determinations and notes secured by a study of the remainder of the Doctor's collection.

CONOLOPHUS SUBCRISTATUS Gray; St.

A specimen from Barrington has a length of body of four and three-fourths and of tail seven and one-half inches.

It is handsomely marked and bears a striking resemblance to species of Enyalioides. This is apparent even in the gular sac and the transverse fold on the throat, and suggests that in our systems these genera are placed too far apart. The coloration differs materially from that of the large specimens. The ground color is of a light olive, lighter and uniform beneath and blotched and vermiculate on the back. Between the nape and the hips on the middle of the dorsal surface there is a series of eight lighter centred, brownish transverse bands, and between these and at their sides on the flank there are streaks forming vermiculations or rings. The rings enclose spaces of the ground color; on the lower parts of the flanks they are larger and more distinct, resembling in a measure those on the flank of *Enyalioides planiceps* as figured by Guichenot. The crown of the head bears scattered spots of black. The tail is brown on the top; on the middle of the side it has a more or less broken longitudinal streak of the light color, below which there is an irregular narrow band of brown separating it from the lighter color of the lower portion.

Size and color are the features in which differences are to be detected between this specimen and the larger ones. Those that obtain are such as will disappear with age. The several large individuals from the same island nearly approach a number secured by the Hassler Expedition, for the Museum Comparative Zoology, from Albemarle. The most notable of the differences between them appear in the higher labials, as compared with the length, and in a more concave frontal region on the specimens from Barrington, which probably represent a distinct variety of the species. The largest is about forty-two inches in length, half of which is tail.

Concerning the dorsal crest there are several items it may be well to notice here. In all cases the crest nearly

or quite disappears between the hips, and on the males it attains a greater development. Each of the large spines of the neck has a small one immediately in front of it, and frequently the latter is preceded by a still smaller one. While young the spines are subpyramidal, convex on the sides and concave behind, but as they grow higher they become more subconical. Early in life the growth is rapid and steady; later it takes on a periodicity that is plainly indicated in the dorsal spines. Those on the Barrington specimens are encircled by three to six ridges, like the rings around a cow's horn. These make the outward appearance of each spine resemble that of the rattle of a small rattlesnake. In a longitudinal section, however, the layers of the epiderm are seen to lie closely against each other, not loosely as in the rattle. When with age the shape of the spine becomes subconical, a slight constriction around the base of the cap, or slough, prevents its removal. The periodic growth of the skin lengthens the spine thus pushing the older cap farther out so as to expose a portion of the base of the new one formed within it. The entire spine being dermal there is no vacant space within the successive caps, consequently, close as the external resemblance is, they do not assume the function of rattles. The appearance is brought about by the shape of the cap, or slough, and the periodicity of the growth. Though not a rattle it confirms my account of the structure and development of that organ as given in 1888 (Bull. Mus. Comp. Zool., XIII, 259). Retention of the several caps adds to the firmness and rigidity of the spine. On one individual the longest spines measure three quarters of an inch.

AMBLYRHYNCHUS CRISTATUS Bell.

Dr. Baur's Collection contains specimens from Albemarle, Bindloe, Charles and Tower, and in this museum

there are others from Albemarle, Charles, Duncan and Jervis islands. All may be placed in a single species, in which it seems possible, however, to distinguish three varieties: first, the typical form of the species, *A. cristatus*, with the young profusely mottled with whitish, greenish and olive and the old reddish, mottled, and clouded with darker on the sides and usually with a black blotch between the shoulders (from Albemarle, Bindloe, Charles and Jervis); second, *A. ater*, the large black form, from Duncan, which exhibits, in large specimens, little or none of the russet color or the mottling; and, third, *A. nanus*, a small black form from Tower island, a form that does not appear to reach half the size of that from Duncan, and which becomes nearly uniform black at a size that in *A. cristatus* has more of green and olive than brown. The smallest specimen of *A. nanus* is five inches in length of body and seven and one-fourth in length of tail; the largest has a body eight inches long and a tail twelve and a half. Two specimens of *A. ater* were secured by Professor Agassiz, on the Albatross, from Duncan. The larger is fourteen inches in body and eighteen and a half in tail. The color distinguishes them at once from *A. cristatus*. Of the latter those from Charles appear to have more of the lighter colors in the young, but in the old there is little difference to be detected between the several localities. The smallest specimen, from Albemarle, measures four and a half inches in body and five and three-fourths inches in tail. It has eight or nine transverse bands, or series of lighter spots, from nape to base of tail, is mottled with lighter on flanks, and is coarsely puncticulate with brown under throat and breast. On the small ones the tubercles of the head are light colored, and spots of the same color form a sort of rosette on the nape. The tubercles of the forehead are flat or convex scales at first, later they become carinate

and finally subconical. On the dorsum the crest is first indicated by convex scales that become compressed and ultimately subconical or pointed. In this genus the crest on the neck shows the appearance of the rattles more than that on the back, the opposite of what occurs on Conolophus.

While looking over the specimens belonging to the Museum of Comparative Zoology with Count Pourtalés, he mentioned a statement of Darwin to the effect that this species does not take to the water for safety, but that when Darwin had thrown them in they immediately returned to the shore. The Count said that, from his own observations, among large rocks where there were fishes the lizards preferred to hide in crevices on shore; but that he saw them along the open places, where there were numbers of them, run into the sea, near the beach where the water was shallow, and secrete themselves under the rocks when pursued from the land.

PHYLLODACTYLUS TUBERCULOSUS Wieg.

This identification may yet be questioned. The specimen in the collection, from Chatham, is badly mutilated. It agrees with Wiegmann's species in the distribution of the tubercles but differs in their shape and size; they are broader and flatter with the keel more distinct from the rest of the upper surface.

PHYLLODACTYLUS GALAPAGOENSIS Pet.

Dr. Boulenger gives the locality of this species as Charles Island. Dr. Baur's specimens are all reported from Albemarle, where it would from his collections appear to be the only species of the genus. The largest individual measures three and three-quarters inches, indicating a smaller species than *P. tuberculosus*, of which specimens

of my collecting in the Daule region, above Guayaquil, reach five and a half. The dorsal tubercles are less developed, and those on the head and neck are less numerous than those of that species, while the large scales below the tail are not arranged in a regular series. Of ten specimens, five have three submentals in contact with the mental, as described by Peters; four of the others have but two submentals in the same position, as stated by Boulenger; and one individual has four submentals against the mental shield. In most respects the descriptions of coloration given by the mentioned authors accords with that present on these specimens. A striking contrast is presented by one example: its ground color is light and the markings are black; between the nape and the base of the tail there are eight transverse bands, bifurcating toward the flank; on the tail there are thirteen of the black bands; and the black band from the nostril through the eye is met at the ear by that from the nape. Ordinarily the dorsal blotches are brown, separated along the vertebral line, and reduced to two series of spots.

PHYLLODACTYLUS BAURII sp. n.

This species is still farther than the preceding from *P. tuberculosus*. There are but five rows of tubercles on each side and they are smaller and more irregularly placed in the rows. The scales of the back of the head and the neck are granular, as in *P. Reissii*. The mental is rather short; it is broad and forms an obtuse angle posteriorly, between two large submentals. The first infralabials are about one-fourth as large as the mental, by which they are widely separated. Forward from a vertical through the pupil there are six labials and five to six infralabials.

The colors and markings are like those of *P. galapagoensis*. The reduction or absence of the tubercles on the

neck brings this species close to *P. Reissii*, described by Peters from Guayaquil; the latter is readily distinguished by its mental shield which is almost entirely between the first pair of infralabials, and these are hardly smaller than the mental itself.

Hab. Las Cuevas, Charles Island.

PHYLLODACTYLUS LEEI Cope.

On one individual there are six labials in front of a vertical through the pupil on one side and seven on the other.

Hab. Chatham Island.

GONATODES COLLARIS sp. n.

Head moderate; snout obtusely pointed, longer than the distance between the eye and the ear opening, one and one-half times the diameter of the orbit, equal the width of the crown at the hinder edge of the orbit; forehead flat; ear opening small. Digits slender; basal joint slender, subcylindrical, with larger plates beneath; other joints more slender, compressed. Head, throat, upper portions of body, limbs and tail covered with subequal granular scales, smallest on the occiput, larger on chin and tail. Rostral broader than high, pentagonal, incised on the top. A small internasal toward each side. Two small shields behind the nostril. Six labials; sixth small, slightly behind the middle of the eye. Five infralabials; posterior nearly reaching a vertical from the hinder border of the eye; first large, in contact with two submentals; mental large, with a median and two lateral angles posteriorly, in contact with a pair of moderate submentals, at each side of which there is one scarcely half as large, from which again a diminishing series of three or four passes back along the infralabials. Abdominal scales moderate, imbricate, heptagonal, flat, similar to scales in front of thighs and arms.

Tail tapering, subround, covered with small imbricate scales above and larger ones beneath. The median row under the tail is subject to great variation: on two of the specimens the scales are about twice as broad as long; on two others they are so broad as to reach from side to side of the tail. The granules of the throat are fine, quite as small as those of the occiput; near the labials and submentals they rapidly increase in size.

Body and limbs dark brownish; back darker, with numerous small spots of light blue. A dark-edged spot of the blue above the shoulder. In front of each shoulder there is a vertical band of bluish that does not reach the median line on the top of the neck. Along the vertebral line the back is lighter, and along this light band there are five pairs of dark spots, and at the hinder edge of each of these spots there is a smaller one of the light color. The first pair of the spots lies transversely in front of the vertical band, the second behind the shoulders, the third near the middle of the body, the fourth in front of the leg, and the fifth across the base of the tail.

Chin and throat yellow to orange. Top and sides of head brown; with a yellow band from the angle of the mouth to the nape, another from the eye to the parietal region, and a third from the nostrils backward over the supraorbitals. On the crown the disposition of the yellow is irregular, but on each specimen there is a short median streak of the light color.

This form is very closely allied to Gray's species *G. ocellatus* from Tobago. The principal differences seem to be in the coloration. The vertical streak is in front of the shoulder, and to reach the latter would have to turn back at its lower end. The head is not so high, and the outline from rostral to occiput is very slightly but quite regularly curved. In the figure given, by Dr. Boulenger,

of *G. ocellatus*, the scales under the fourth toe are smaller toward the base; in our species they are about equal in size.

Hab. Wreck Bay, Chatham Island.

OROPHIS BISERIALIS.

Herpetodryas biserialis Gthr., 1860, Pr. Zool. Soc. Lond., 97.

Dromicus Chamissonis Pet., 1869, M. B. Berl. Akad., 719.

D. Chamissonis var. *biserialis* Gthr., 1870, Zool. Rec., VI, 1869, 115.

D. Chamissonis var. *dorsalis* and var. *Habelii* Steind., 1876, Schl. u. Eid. der Galap.-Inseln, p. 6, pl. 1.

Opheomorphus Chamissonis Cope, 1889, Pr. U. S. Mus., 147.

There is a single specimen of this snake in the collection from Hood Island. It is intermediate between Günther's species *biserialis* and Steindachner's variety *Habelii*. Structurally it agrees with the type described by Günther, but it has no spots on the back. The dorsal band is continuous, though fainter and indistinctly margined behind the middle of the length. The type from which the species was originally described was said to be from Charles Island. The present specimen from another locality possesses the squamation of one of the so-called varieties and the coloration of the other. This seems to me to indicate the existence of but one variety, of which the spotted forms and those with three postorbitals are individual variations. There is nothing in the published evidence to show that the striped form, the spotted form, that with two postorbitals, and that with three do not occur amongst the individuals of any of the localities inhabited by this snake.

Günther's type has three postorbitals and is spotted, Dr. Baur's specimen has three postorbitals and is striped, and Steindachner's varieties both striped and spotted have but two postorbitals.

Steindachner's specimens are from Charles, Hood, Indefatigable, and Jervis Islands, Baur's and Günther's are from Charles and Hood.

The species was first placed by Dr. Günther in Herpetodryas. Peters removed it to Dromicus. The type species of Dromicus is *C. angulifer*, with two scale pores, which differs too much to admit of including the Galapagos serpent with it in the same genus. Liophis was based by Wagler on *L. miliaris* or *L. Merremii*, and Opheomorphus thus becomes a synonym, being founded on the same type. Since Fitzinger, 1843, has applied the name Orophis directly to *O. Chamissonis* it would appear that the best way out of the confusion lies in retaining his generic designation for that species and others not generically distinct.

Orophis biserialis differs from *O. Chamissonis* mainly in having a larger number of scutes. Our specimen has 19 rows, no pores, 209 scutes under the body, a divided anal, a mutilated tail, one loreal, one anteorbital, three postorbitals, eight labials, and ten infralabials. The frontal does not widen in front; between the supraorbitals its sides are parallel. The lateral band of light color extends along the two outer rows of scales, and the upper light band is on the sixth and seventh rows. The dorsal band of brown occupies five entire rows with the adjoining edges of two others; the lateral bands of this color occupy but three rows with the adjoined edges of two more. All of the bands fade posteriorly. The lateral bands of brown begin at the nostrils and pass through the eye to the flanks; the dorsal band begins on the forehead, where it is not so dark. Anteriorly there are spots under the body; pos-

teriorly the spots do not appear and the color is more uniform white or yellowish. The edges of the scales are darker. The greater part of the brown in the coloration is in the shape of coarse puncticulations; these are continued more or less completely across the abdomen on the hinder edges of the scutes. On its edges the dorsal band has the appearance of being serrated. Dr. Günther found 209 ventral scutes on the type specimen. Steindachner found the ventrals on his examples to vary from 219 to, 225 and the subcaudals from 105 to 114. On *O. Chamissonis* the ventrals vary from 175 to 201 and the subcaudals from 100 to 113.

Mus. Comp. Zool., Jan., 1892,
Cambridge, Mass.

ON REPTILES COLLECTED BY DR. GEO. BAUR NEAR GUAYAQUIL, ECUADOR.

BY S. GARMAN.

Though it contains but few types, this collection is of interest because of the means it affords for determining a number of individual variations, and for perfecting to some extent several of the original descriptions, and also for reducing the number of nominal species. The specimens were secured either in the immediate vicinity of Guayaquil or, along or off the coast, on the way from that city to the Galapagos Islands.

Pelamis platura Linn.; Garm.

Four specimens of this sea snake were taken opposite Santa Helena. The first has 53 scales in a row around the body near the middle, nineteen of them being included in the black color of the back. In a row from the chin to the tip of the tail there are 344 on the body, and 52 on the tail. Around the middle of the tail there are 27 rows. On each side of the head a large anteorbital reaches from the prefrontal to the lower of the two postorbitals. None of the labials reach the orbit.

On the second there are 56 scales in a row around the middle of the body; and in a line from the chin to the end of the tail there are 355 scales on the body, and 48 on the tail. Seventeen of the scales around the body are in the

black. In this case there are two anteorbitals on each side, the lower one extending between the orbit and the labials to the lower of the two postorbitals. In the middle of the yellow color of the flank a black band passes back from the lower jaw over more than one-third of the length; behind this it becomes a series of large spots; and these latter, toward the tail, extend downward to the median ventral line and join the spots from the opposite side to form transverse bands.

The third example has 53 rows, nineteen of them in the black, and in the ventral series has 340 on the body, and 45 on the tail. On one side of its head there is one anteorbital, which is separated from the lower of the two postorbitals by the fifth labial. On the other side there is a single postorbital; this is separated from the lower of the two anteorbitals by the fifth labial. There are eight labials, of which the fourth is small and crowded under the third and fifth. Infralabials 11–12.

The fourth individual has 53 rows of scales, seventeen of them black; and in the ventral series there are 351 on the body, and 49 on the tail. It has two anteorbitals on one side, the lower one united with the fourth labial and extended below the eye to the lower of the two postorbitals. On the other side it has two ante- and two postorbitals, with a large suborbital between the eye and the labials.

Only one of the four specimens has black in the yellow of the flank. On two of them the black of the back is regular in its lower margin to the base of the tail, where it breaks into rounded blotches which descend on the sides and alternate with others extending up from the lower edge of the tail. On the other two the black of the back becomes sinuous in its lower edges, not far from the middle of the body, and breaks up on the tail, where scattered small spots of black appear.

LEPTODEIRA ANNULATA Linn.; Fitz.

Considerable individual variations are shown by the eleven specimens in the collection. Six have 21 dorsal rows; five have 23. The scutes range from 185 to 194, averaging about 189. The average of the subcaudals is nearly 82, the range being from 72 to 90. The normal number of labials is eight, on one side of each of two specimens there are nine. There are ten infralabials; on both sides of one specimen and on one side of each of two others there are eleven. Normally there are two ante- and two postorbitals, and the fourth and fifth labials enter the orbital ring. On one side of one specimen there is a single anteorbital and the third, fourth and fifth labials enter the orbit; and on both sides of another there are three postorbitals, while on one side of the same specimen there are three anteorbitals. The dorsal blotches vary from 40 to 54 on the body, averaging about 45; and those on the tail range from 17 to 25, with an average of about 22. On some the dorsal blotches are transverse, undivided on the median line; on others they seem to be divided above the vertebræ and alternated and joined in such a manner as to form a sinuous line, crossing back and forth from side to side of the dorsum for a considerable extent of the entire length. In young stages the ground color is much lighter and the spots are more distinct. The scales have two pores; anal and subcaudal scutes are divided.

HERPETODRYAS BRUNNEUS Gthr.

Rows 17, pores 2, scutes 155 + 122, and 154 + 131, anal and subcaudals divided; labials 9, infralabials 10, a loreal, one anteorbital, postorbitals 2, three on one side of one specimen, fourth to sixth labials in the orbital ring. The length of one is $11\frac{1}{2}+6\frac{5}{8}$, and of the other $19\frac{1}{2}+13$ inches.

On the younger the light vertebral space is more distinct, as also the narrow bands of darker at each side of it, in which there are small black spots. On the larger the color is a darker olive in which many of the scales are tipped with black. Nine of the dorsal rows are keeled.

HERPETODRYAS RETICULATUS Pet.

A young specimen with 17 rows of scales, 186 ventral scutes, a divided anal, and a mutilated tail. Labials 9, infralabials 10, one anteorbital, postorbitals 2. The fourth to the sixth labials are in the orbital series. To the base of the tail there are 82 blotches. Ventral surface without black spots; no white spots or white-edged scales on flanks or back. In the quadrangular blotches of the back the central portions are lighter, as also of the scales. This form is evidently closely allied to *H. Rappii* of Günther.

CONIOPHANES SIGNATUS sp. n.

Body slender, elongate, slightly depressed. Head little wider than neck, crown flattened, snout moderately pointed, loreal region concave. Scales smooth, lustrous, elongate, poreless, in 19 rows around the middle of the body. Ventral scutes 132, anal and subcaudals bifid, tail mutilated. Rostral not bent back on the snout. Internasals not half as large as prefrontals, broader than long. Prefrontals large, broad, bent down to the loreal. Nasals two, loreal as high as long, labials 9, fourth and fifth in orbit, eighth small, not as large as the loreal, longer than high, seventh and ninth large, one anteorbital, two postorbitals, infralabials 10, two pairs of submentals. The maxillary teeth increase in size backward; the posterior one is grooved. A dorsal band of brown occupies five scales, and a half scale at each side of these; a light line

at each side of the dorsal band includes two entire and two half-scales, and the brown band at the lower edge of each flank covers the three outer rows, the half of the fourth, and the ends of the ventral scutes. In the dorsal band there are two narrow streaks of light color, on the middle of the scale, and on the lower band of the flank there are three similar streaks, the upper two of which are close together. On each side of the nape there is an oblong area of lighter color surrounded by dark, and the outer portions of the temporals are lighter. The dark brown of the middle of the crown extends forward on the frontal, forming a trident with the prongs in front, ending on the prefrontals. A dark band passes through the eye to the neck; below this a light band passes back into the pair of white streaks in the second and third rows of scales. Lips, chin and throat thickly freckled with brown. A peculiar feature of this snake is the smallness of the eighth labial as compared with the ninth or the seventh. It is longer than high and lies below the lower temporal which is larger than the upper and passes downward between the seventh labial and the ninth to the eighth. The specimen is alike on both sides of the head.

Oxybelis aeneus Wagl.

Labials seven to eight; infralabials nine. From Posorja.

Cnemidophorus lentiginosus sp. n.

Head narrow. Nostril anterior to the nasal suture. Each of the outer parietals transversally divided into three. Four supraoculars, the posterior two and half of the second separated from the frontal and the fronto-parietal by a line of granules, six to seven supraciliaries, a freno-orbital, median gular scales enlarged, mesoptychium with four or five rows of enlarged scales, smaller but not gran-

ular toward the edge of the collar. Dorsal granules small, uniform. Ventral plates in ten longitudinal and about thirty-four transverse series. Five large plates forming a triangle, from the vent 2 + 2 + 1, at each side of which there is a series of five smaller ones. Three or four rows of brachials, anterior largest and continuous with the largest, posterior, of the two rows of antebrachials. Eight to ten rows of femorals, two or three of which are large; tibials in three rows, outer largest. Femoral pores twenty to twenty-one on each side. Male without anal spines. Caudal scales slightly oblique, carinate, subtruncate posteriorly. Length of body, 4.25, of tail, 7.75 inches.

Back olive brown, tinted with red anteriorly; upper surface of body and limbs and sides of head thickly sprinkled with small rounded spots of yellowish or white, apparently arranged in both longitudinal and transverse series; top of head lighter brownish, uniform; a series of spots from ear to rostral on the labials; lower surface olive, reddish on chest and folds, yellowish under legs, tail and hinder parts of abdomen. A faintly indicated light streak extends from the supraciliaries back above the hips.

Hab. San Francisco de Posorja.

Ameiva edracantha Boc.

A small posterior, fourth, supraocular is present in each case. Supraciliaries five to six. Granules scarcely intervening between fronto-parietal and supraocular. Pores twelve to thirteen. Throat of male red-tinted. Males with six large and several smaller spines in each group at the sides of the preanals.

Hab. Posorja.

Iguana tuberculata Laur.

Secured at Posorja.

TROPIDURUS OCCIPITALIS Pet.

Tropidurus (*Læmopristis*) *occipitalis* Peters, 1871, M. B. Berl. Akad., 645.

Aneuporus occipitalis Bocourt, 1874, Miss. Sci. Mex., Rept., 215, pl. xviii, fig. 1.

Craniopeltis occipitalis Cope, 1876, Jour. Phil. Ac., (2), VIII, 173.

Tropidurus occipitalis Boulenger, 1885, Cat. Liz., II, 173.

Tropidurus Bocourtii Boulenger, 1885, Cat. Liz., II, 173.

On the shields of the snout the keel is very feeble or absent. The supraorbitals have faint striæ. Frequently, especially in the young, the occipital black spot is bordered by white. The dorsal crest is very prominent on old males ; it is less so on the females, and is indicated by broad scales with a median keel, but without the acuminate point, in the young. On the larger ones there are four (4–6) acute scales on the front margin of the ear. Behind the arm, extending back along the flank the male in life has a group or band of red spots. The females and the young do not show this but they have a narrow band of lighter color from the upper edge of the arm to that of the thigh. The humeral fold is usually black inside. Females and young have the fold in front of this of a brilliant red color. On the female the dorsal blotches are much reduced and less distinct. On the male the four blotches of the scapular region are large and jet black. The young ones have eight or nine moderately distinct transverse bands of brown between the nape and the base of the tail, the series becoming more faint as continued farther back. The two light bands along each flank are very distinct on the young.

Young ones closely resemble Scelopori in appearance and coloration.

Bocourt's genus Aneuporus appears to have been founded on the female of this species. Cope's Craniopeltis is apparently the same. From their descriptions Boulenger was led to found the species *T. Bocourtii*, which, from the evidence of Dr. Baur's specimens, becomes a synonym of *T. occipitalis* of Peters.

From San Francisco de Posorja, on the north side of the gulf, between Guayaquil and Point St. Helena.

Phyllodactylus tuberculosus Wieg.

From Guayaquil.

Mus. Comp. Zool. Feb., 1892, Cambridge, Mass.

ON COPHIAS AND BACHIA.

BY S. GARMAN.

Cophias as a generic name for South American reptiles dates from 1820, when Merrem, Syst. Amph., applied it to a genus of the Toxicophidia. Of the species he included four or five rightfully belonged to previously established genera. After removing those of Lachesis, Daudin, 1803, and Trigonocephalus, Oppel, 1810, there remained but two to bear the name proposed by Merrem. Wied-Neuwied in his Reise, 1821, in his Abbildungen, 1824, and in his Beiträge, 1825, uses this name for species correctly placed with these. Wagler, 1824, in the Spix Reptilia gave the name Bothrops to a genus containing Lachesis and a number of species belonging with the two from Merrem and those of Wied, through which Cophias really anticipates Wagler's name, though that term has been adopted by recent authorities.

Previous application and repeated use among the Ophidia notwithstanding, Fitzinger, 1826, Syst. Rep., 20, gave the name Cophias to a genus of lizards, distinguished by three toes on the hind foot. The only question in this note is whether we are justified in retaining this name among the Sauria. From the data given above it does not seem possible to do so in accord with general practice. In fact the necessity of selecting another title for the genus of lizards so named appears unavoidable. If we accept the genus

as constituted by Dr. Boulenger, 1885, Cat. Liz. Brit. Mus., II, 417, we find that because of application elsewhere neither Chalcides, Chalcis, Colobus, nor Microdactylus, sometime applied to one or others of the species, is available, and we must turn to the next in order. One of the included species, that described by Duméril and Bibron, 1839, Erp. Gén. v, 462, Chalcides D'Orbignii, was made the type of the genus Bachia by Gray, 1849, Cat. Liz. B. M., 58. At the time this was the only species. Boulenger, 1885, determines that three others are congeneric. By extending the limits of the genus so as to include them, and leaving the name Cophias to the snakes, we shall solve the difficulty and preclude further confusion. At present the following species are placed in Bachia :

B. D'Orbignii D. & B ; Gray.	Chile ; Venezuela.
B. flavescens Bonnat. sp.	Guiana ; Venezuela.
B. heteropus Boettg. sp.	Central America.
B. tridactylus Daud. sp.	Hab ?

Mus. Comp. Zool., Cambridge, Mass.

ON TEXAN REPTILES.

COLLECTED BY MR. F. W. WAMSLEY FOR PROFESSOR J. W. P. JENKS, CURATOR OF THE MUSEUM AT BROWN UNIVERSITY.

BY S. GARMAN.

MR. WAMSLEY'S collection was gathered at Deming's Bridge in Matagorda county, one of the gulf series of counties, situated eastward from the central meridian of Texas. In all, the lot contained seventy-two specimens, representing twenty-eight species of nineteen genera. Twenty-one species of fourteen genera were snakes, three species of three genera were lizards, and four species of two genera were tortoises. On account of the larger number of specimens and of the comparisons with descriptions given by Baird and Girard, many of whose types were secured in localities not far from Deming's, the greater interest attaches to the serpents. It will be noticed that the statements of the mentioned authors are closely approached by the data noted in this list.

As there appears to be no other way to secure anything like permanence in the names applied, it is thought advisable to trace the nomenclature back and to determine them in strict accord with the rules applying in regard to priority.

CHELONIA.

CISTUDO ORNATA Ag.

On one of the specimens the areolæ are so much raised that, with the radiating yellow lines, the scales in a measure

resemble those of *Testudo radiata.* An individual with a carapace measuring four and one-half inches in length by three and one-half in width has less than fourteen lines of growth on each scale. The top and the sides of the head are flecked with small round spots of yellow. In all cases the vertebral keel is obsolete.

CISTUDO CINOSTERNOIDES Gray; Garm.

Dr. Boulenger has examined the type of Gray's *Emys kinosternoides*, 1831, and, finding it to be identical with *Cistudo triunguis* of Agassiz, 1857, makes it a variety of *C. Carolina.* Of one of our specimens the head is yellowish green on the top and the sides with a faint yellow spot or two far back on the top and a few larger ones on the sides behind the ears. This one is less than four inches in length of carapace and the scales are smooth, or with traces of striæ posteriorly. On the carapace the brown color is dark and the yellow is reduced to scattered small rounded spots; on the plastron the yellow spots are elongate or form short bands, but this color is much less in amount than the brown. Another specimen, with a shell five and a half by four inches, has the head of a chestnut-brown on top and sides, freckled with a few small spots of orange behind the mouth. The carapace is chestnut-brown, darker on the areolæ and the posterior borders of the scales on each of which there are faint traces of radiating lines of lighter color. The plastron is yellowish, darker in the sutures. Except in the lack of markings on its head this individual agrees closely with that figured by Wied as *C. Carolina*, apparently also a three-toed specimen. Each specimen in the collection has the labial scale of orange color with dark edges.

Objections are urged against the use of the name Cistudo as it was originally, as also Terrapene, a synonym for

Emys or Emydes of Brongniart. If we are to discard it, the next available name would seem to be Emydoides (orig. Emyoides) of Gray, 1844; or if this be put aside for lack of a diagnosis we shall have to adopt Onychotria of Gray, 1849, which is manifestly inappropriate for the majority of the species to be included.

TRACHEMYS TROOSTII Holbr.; Ag.

These examples do not differ greatly from others taken in Mississippi. There is some variation among the specimens in regard to the narrow longitudinal lines on the head and neck, one having them broken up into mottlings. On the sides of the head and beneath, the lines are more or less irregular and broken. The scales of the carapace have black margins. In general the appearance is very dark, almost black. Under the plastron there is a considerable of a mixture of dark brown, brownish and yellow of various degrees of depth, the darkest color following the sutures. One of the shells measured nine inches in length by six and seven-eighths in width.

A lot of nine eggs was taken, on the twenty-third of May, which presumably belongs to this species. The shape is similar to that of *Ptychemys mobiliensis*, as figured by Agassiz; the size is a little greater. The largest in this lot measures one and eight-tenths inches in length by one and one-tenth in width. The smallest was one and sixty-five-hundredths inches by one inch. Another lot contained eleven eggs; the largest, one and sixty-three-hundredths inches by one and four-hundredths; the smallest, one and forty-seven-hundredths by one inch.

TRACHEMYS ELEGANS Wied; Ag.

The shell measured six and twenty-five-hundredths by five inches. The free portion of the longest claw was five-eighths inches long.

SAURIA.

PHRYNOSOMA CORNUTUM Harl.; Gray.

LYGOSOMA LATERALE Say; D. & B.

The specimen has thirty scales in a row around the body, a smaller scale at each side of the pair of large preanals, and a pair of narrow lines of brown from the nape to the base of the tail along the middle of the back.

OPHISAURUS VENTRALIS Linn.; Daud.

One hundred and twenty-seven scales from chin to vent. Eleven labials.

OPHIDIA.

SISTRURUS CATENATUS Raf.; Garm.

One specimen had dorsal rows 25, ventral scutes 157, subcaudal scutes 25, labials 12, infralabials 13, and dorsal blotches 41, on the body, plus 7 on the tail. Another had rows 25, ventrals 155, subcaudals 3 pairs plus 31 entires, labials 13–14, infralabials 12–13, and dorsal blotches 43 on the body and 8 on the tail.

SISTRURUS MILIARIUS Linn.; Garm.

Rows 21, scutes 134, subcaudals 25 entire plus 6 pairs, labials 8–9, infralabials 9, anteorbitals 3, postorbitals 5. The red band on the back is very distinct.

ANCISTRODON PISCIVORUS LaC.; Cope.

Five specimens. Rows 25, scutes 135-137, subcaudals 39–44, labials 7–8, infralabials 10–11. The number of bifid subcaudals under the end of the tail varies from six to twenty, among them there are occasional entire scutes. A half scute frequently occurs immediately in front of the left half of the anal.

Comparison of these with specimens from the eastern section of the range discovers no grounds for separation as

a variety. On individuals there is considerable variation in the width of the lower edge of the second labial; in cases it approaches an acute angle at the mouth, where in others it presents a broad margin. But one of the labials enters the orbit. On a specimen in the Museum of Comparative Zoology the second labial presents a sharp angle downward but does not reach the mouth. Mr. Wamsley's specimens show the tail to be dark and the bands to be almost obsolete on the backs of the larger ones but very distinct on the young. The band behind the eye is distinct on the small ones; with age it becomes indistinct on its upper edge.

Baird and Girard give 145 scutes for *A. pugnax* and 140 for *A. piscivorus;* our highest number is 137.

Elaps fulvius Linn.; Cuv.

Three specimens. Ventrals 207, 212, and 213; subcaudals 40, 41, and 42, bifid; labials 7; infralabials 7. On one the yellow bands number 24 + 3, on each of the others 22 + 3. One red band is nearly as wide as one black plus two yellow ones. The tail is black and yellow only. The lengths are 22 + 3, 19·5 + 2·75, and 17·5 + 2·5 inches.

Compared with others from the southern states east of the Mississippi, these specimens show plainly that *Elaps tristis* of Baird and Girard was founded on insufficient grounds. They are not distinguished by the shape of the heads. On a series from South Carolina the scutes number 204, 206, 208, 211, and, on a large female, 222. Others from Florida have 208, 209, 209, 210, and 225; one from Georgia has 208; and one from Alabama has 211.

Elaps tenere B. & G.

A single specimen in the collection may be placed in

this species. It has 229 ventrals, and 29 bifid subcaudals. On one side there are seven labials, second and third in orbit, on the other there are eight, third and fourth in orbit. There are 24 + 2 yellow rings; the red are much spotted with black, and each is about as wide as one of the black plus two of the yellow. Tail black and yellow.

TROPIDONOTUS OBLIQUUS Hallow.

This type agrees with *T. fasciatus* in structural details, but differs greatly in coloration. Rows 23, ventrals 132, labials 8, infralabials 10–11, 1 anteorbital, 3 postorbitals. Across the back there are about sixteen blotches of black separated by irregular obliquely transverse narrow streaks of yellowish that widen on the flanks. Toward and on the ventrals the blotches become reddish and more or less bifid. The first blotch is a wide one and extends forward on the neck and top of the head to the rostral. The margins of the labials have very little of the brown color, and the bar behind the eye is partially obliterated and indistinct. In the Mus. Comp. Zool. there is another specimen of this form, from Dallas, which has rows 23, scutes 135, subcaudals 77, labials 8, and infralabials 10–11. On this one the brownish red of the blotches extends nearly half way across the lower surface. Tail uniform dark brown.

This form is close to the type described by Hallowell from Kansas, but differs in the number of blotches, unless they are counted along the outer rows of scales on the flanks. His specimen had 140 ventrals, 69 subcaudals, and 32 + 18–19 blotches. On the young no doubt the blotches are less confluent.

TROPIDONOTUS TRANSVERSUS Hallow.

Of ten specimens the first two have 23 rows, the third 27, and the remainder 25 rows each. Their scutes, anal

and subcaudals being bifid, number 142 + 75, 146 + 78, 143 + 65, 148 + 71, 151 + 72, 148 + 70, 150 + 68, 150 + 74, 144 + 77, and 147 + 76. Commonly there are eight labials and ten infralabials; the latter vary from ten to twelve. One specimen has two anteorbitals on one side. Another has two postorbitals on one side instead of the usual three. Several have the scales of chin, snout and lips roughened with small tubercles or papillæ. The dorsal blotches vary from 31 to 36, and the caudal from 19 to 23. On the large ones the color of the back becomes nearly uniform dark brown. Small ones have a lighter ground color, blotches more distinct, and the two parietal yellow spots usually present. The tendency to form transverse bands is not so evident in this species as in its nearest ally *T. sipedon*. Beneath the anterior margin of each scute, toward the sides, there are crescent-shaped spots of dark color; on some of the older ones these spots have widened and lengthened until nearly the whole scute is covered; on other individuals these spots are nearly obsolete. A frequent variation in species having the bifid anal is to be seen in several of these specimens. In the anal scute the dividing line is oblique, and extends back and toward the right side, thus making the left portion the larger. It is in front of this, the larger half, that a small supplemental or half-scute appears. Two of the ten before us have a half scute in front of the left half of the anal, and a third has a smaller piece which does not quite reach from the median line to the lateral rows.

This is the species named *Nerodia Woodhousii* by Baird and Girard, 1853. Hallowell's name was applied in 1852.

THAMNOPHIS SIRTALIS Linn.; Garm.

Labials 7, infralabials 10, 1 anteorbital, postorbitals 3, and rows 19 in each of the four specimens. The ventrals

and subcaudals number 147 + 74, 142 + ?, 139 + 74, and 149 + 86. In a dorsal series the spots range from 73 to 82.

This genus is Eutænia of Baird and Girard, 1853. Fitzinger, 1843, applied the name Thamnophis to the species *T. saurita* of Linné. The habits of the species make the name (from θάμνος, copse, thicket, or bush) a most appropriate one.

THAMNOPHIS PROXIMA Say; Garm.

Ventrals ranging from 167 to 175, and subcaudals from 107 to 108. In one case there are eleven infralabials instead of ten.

STORERIA DEKAYI Holbr.; B. & G.

Two anteorbitals on one side of one specimen. Ventrals ranging from 135 to 138, and subcaudals from 51 to 53. The dorsal band varies from distinct to indistinct, and a series of small black dots at each side of the belly is present or absent. Apparently there is an increase in the number of scutes to the southward.

POTAMOPHIS INORNATUS Garm.

The types from which this species was described were secured near Dallas. Their principal difference from *Potamophis striatula* appears in the divided internasal, lack of an occipital ashy band, and in a stouter form.

Two specimens of this lot agree in the main with the types but have a single internasal and a larger number of scutes. For the present they are placed here to wait a larger series from which to determine the value of the differences. Each has 17 rows, 5 labials, 1 anteorbital, 1 postorbital, 1 internasal, and divided anal and subcaudals. One has 6 infralabials, 139 ventral, and 38 subcaudal scutes; the other has 6 infralabials on one side,

but 5 on the other, 139 ventrals, and 37 subcaudals. The length of a female, apparently adult, is 8·5 + 1·6 inches.

A name meaning river snake, Potamophis, given by Fitzinger in 1843 to Linné's *Coluber striatulus*, is certainly not a very appropriate name for this genus. The next in order of publication would be Haldea of Baird and Girard, the only advantage of which would seem to be in that it has no meaning at all. If both of these names were dropped, the more applicable name, Conocephalus, given by Duméril in 1854, would be the next available.

HETERODON COGNATUS B. & G.

In each case there are 25 dorsal rows and, with one exception of 10, 11 scales in the orbital chain. Two specimens have 8 labials and 11 infralabials on each side; a third and a fourth have 8 labials on one side and 9 on the other; the third has 10 infralabials on one side to 11 on the other, while the fourth has 11 on each side. Anal and subcaudals all bifid. Scutes 139 + 44, 131 + 49, 137 + 43, and 134 + 39. The blotches in the dorsal series number 25 + 7, 25 + 9, 24 + 9, and 23 + 8. Form and coloration serve to distinguish this snake readily from *H. platyrhinus*. The light color beneath the neck and the tail makes it appear as if both neck and tail were carried off the ground.

LAMPROPELTIS DOLIATUS Linn.; Cope.

Rows 21 in each case, scutes 201 + 49, and 201 + 47, 24 red bands on one, and 20 on the other. Labials 7 on the first, 7 – 8 on the second; infralabials 9. This and the two following species represent Ophibolus of Baird and Girard.

LAMPROPELTIS RHOMBOMACULATUS Holbr.; Cope.

Rows 25, scutes 208 + 52, and 207 + 51. Dark

blotches on the back to the base of the tail; 59 on one, 56 on the other. Labials 7; infralabials 10, one has but 9 on one side. Scale pores two.

LAMPROPELTIS SAYI Holbr.; Cope.

Rows 21, scutes 213 + 49, 222 + 51 and 205 + 47, labials 7, infralabials 9, in a single case 10. Each scale bears a yellow spot, yet the arrangement is such that it is possible in cases to count the blotches, which are found to be about 75 + 22.

DIADOPHIS DOCILIS B. & G.

A female with eggs; length 13½ + 2¼ inches. Scutes 177 + 39, labials 7, infralabials 8. Lower surface profusely and irregularly spotted with black. Neck band orange. Posteriorly a black blotch reaches out from the flank, on the end of each scute, more than one-third of the way across.

COLUBER FLAVIVENTRIS Say.

Labials 7–8, infralabials 8–9, scutes 168 + 78, 162 + 79, and 170 + 74; lengths 24 + 7·5, 23 + 8, and 13 + 3·75 inches. The youngest is thickly sprinkled with small spots of dark color and has about 80 transverse blotches on the body, to the tail.

Commonly there appears to be but a single pore to each scale; frequently there are two, and near the base of the tail some have three. By Baird and Girard this species was placed in Bascanium.

COLUBER TESTACEUS Say.

Labials 8–7, infralabials 10–11, scutes 187 + 94, 191 + 107, 194 + ?, and 192 + 99. Pores normally two, frequently but one, occasionally absent, sometimes three or four on a scale near the base of the tail. To the rule

calling for lighter color under the neck these snakes are exceptions; they are darker anteriorly and spotted under the neck. The lighter color of the entire hinder portion of the body apparently indicates that the species is in the habit of lying in cover with but half of the length exposed. This is *Masticophis flavigularis* of Baird and Girard.

CYCLOPHIS VERNALIS (De K.) Harl.; Gthr.

Labials 7, infralabials 7–8, scutes 143 + 71, and 139 + 85.

PHILOPHYLLOPHIS MAJALIS B. & G.; Garm.

Labials 7, infralabials 8–7, scutes 166 + 117, and 164 + 115. This form seems to have a greater number of scutes under the body and a smaller number under the tail than *P. æstivus*. On the latter the body has about 155, and the tail about 130.

The genus Philophyllophis was founded for *Coluber æstivus* of Linné. That species was placed in Opheodrys by Fitzinger, 1843, followed by Cope. Gunther, 1858, placed it in his Cyclophis the type of which is *C. vernalis*, a form we can hardly regard as congeneric. The word Opheodrys is a play upon the roots of Dryophis of Boie, 1827.

PANTHEROPHIS LINDHEIMERII B. & G.; Garm.

According to the original description of this species it differed from *P. alleghaniensis* in having twenty-nine rows of scales and a lighter coloration. The five specimens at hand agree with these statements in regard to colors, but differ in having only twenty-seven rows, thus agreeing in this respect with the species from the northeastern states. The differences between *P. alleghaniensis* and *P. Lindheimerii* parallel those existing between the Colubers, *C. constrictor* and *C. flaviventris*. Instead of the glossy black

obtaining in the eastern form the Texan has a brownish color in which the dorsal blotches are persistent. The spots vary from light brown to dark, but are in no case black, and the ventral surfaces are more yellow than brown. The white-edged scales of the back are present in all, and the blotches of the larger ones show no indication of becoming obsolete. On the flanks there is a reddish tint. There are 29 to 33 dorsal blotches, to the base of the tail. The tail is more uniform in color, and darker on the larger specimens.

Rows 27, labials 8, infralabials 13, in one case 12, 1 anteorbital, postorbitals 2, on one individual 3 on each side, scutes 236 + 87, 230 + 85, 229 + 84, 226 + 81, 229 + 83. One individual has a half-scale in front of the left half of the anal.

This genus is Scotophis of Baird and Girard, 1853; it was indicated by Fitzinger, 1843, under the name Pantherophis having as the type species *Coluber guttatus* of Linné.

Mus. Comp. Zool., Cambridge, Mass., Dec., 1891.

NOTICE TO A SOLDIER.

Salem, Sept. 30, 1777.

To Mr. David Masury,

Sir:

In pursuance of orders from the commanding officers of this regiment I hereby detach yon to serve as a soldier agreeable to a resolve of the General Court of the 26th instant, being thus detached you are hereby ordered to appear in School Street to-morrow at 3 o'clock in the afternoon with a good firelock, accoutrements and blanket, there to join the company and receive further orders from Capt. Benjamin Ward. Hereof fail not as you would avoid the penalty of the Law.

Joseph Sprague, *Major.*

SLAVERY IN MASSACHUSETTS.

The Boston and Salem newspapers a few years before the Revolution, contain many advertisements of slaves to be sold, and in some instances to be given away. In the latter case it was probably where such help could not be made profitable to the owners for some reason or other; perhaps the holders had no employment, or perhaps the slaves were too young or inefficient. Whatever the reason might be, bills of sale occasionally turn up where even

children commanded a good price. Among the Essex Institute MSS. we find the following Bill of Sale, which may be of some interest.

Cambridge, June 22, 1761.

M[r]. Peleg Sterns bot }
of Henry Price }

A negro boy named Jack about six years and ten months old. Helthy and Sound for the Sum of thirty Six pound thirteen Shillings and four pence Lawfull Mony—£36 : 13 : 4—which Negro I have a Just Right to Sell as witt[s] My hand.

Henry Price

Errors Excepted
pr Henry Price.

Witt[s]

her
Rachel × Swinnerton.
mark

Beniamin Jennings.

REVOLUTIONARY LETTER.

"*Camp at Providence June 28[th] 1777.*

I congratulate you my dear Sir on the recovery of your family from the Small Pox (which by the bye I am not obliged to Major Sprague for the Knowledge of).

The Gentl[n] by whom I shall send this sets off this morning for Boston, (as Col. Titcomb did the day before yesterday) to know what the court will do concerning a new supply of Troops to take place of those now here, whose time of service is just expiring. I have not time to be lengthy (thats well says you) as the gentl[n]. only waits to take a letter from the Gen[l]. relative to a piece of intelligence bro't by M[r]. Commissary Waterman of this department who arrived here last night from New London and

brings acct that one Bulkly a man of character belonging to Connecticut came off from one of the British ships where he was a prisoner who says that last Sunday a smart ingagement happened between the Rear of Hows army on their retreat & the front of Gen[l]. Washingtons, that Hows army had all retreated to Statten Island & that the Transports were ordered round to take the troops on board, that he the said Bulkly himself saw 3 flat bottomed boats with Dead & wounded landed on the Island, that the officers on board were uncertain where they designed for, their conjecture being various, some supposed Connecticut, some Rhode Island, this acct. is from the Gen[ls] own mouth. Major Hovey, the Bearer of this to Boston waites, or I would be more particular—hurry must excuse inacuracies. I yesterday saw a Halifax paper of the 25[th] May in which were a number of abominables amongst which was the case of Seaton which I wish you would call on Mrs. Hiller and see.

I am

Saturday morn, Sir yours unalterably

Major Sprague. J. Hiller."

This is addressed to

Major Jos. Sprague Esq.
Salem.

BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 24. SALEM: JULY, AUG., SEPT., 1892. NOS. 7, 8, 9.

THE WA-WAC-KA-TCI-NA, A TUSAYAN FOOT RACE.

BY J. WALTER FEWKES.

AMONG the customs of the Indians of Tusayan,[1] there are none more suggestive from an ethnological standpoint than the games and races of these people. In many of the great nine days religious festivals, as the Snake Ceremony, the Flute, and the *Lā′-lā-kon-tì*, races up the mesa trails are introduced on the morning of the ninth day. These races, which I have already described,[2] have many resemblances to each other as pointed out elsewhere, and are necessary parts of the ceremonials, which make up some of the more important religious celebrations.

[1]The following observations were made while connected with the Hemenway Expedition in the summer of 1891. By the Indians of Tusayan I mean the acolents of the northeastern part of Arizona, or those commonly called the "Mokis."

[2]Descriptions of the ceremonial rites mentioned above will be found in the *Journal of American Ethnology*, and *The American Anthropologist*. (For Flute Ceremony, *Journ. Am. Eth. and Arch.* Vol. II, No. 1; *Lā′-lā-kon-tì, Am. Anthropologist*, April, 1892.)

The Tusayan or Moki Indians at present live in seven villages of which O-rái-bi is the most populous, the most distant from the railroad and therefore least modified. These village Indians have built their pueblos for security against foes upon lofty mesas approached by steep trails. The East Mesa or First Mesa is the site of three villages called Wál-pi, Si-tcúm-o-vi, and Hā′-no or Tē-wa. Of these three Wál-pi is the most populous and Si-tcúm-o-vi the smallest. They are situated on the flat platform which forms the top of the mesa, in a space not more than a half mile in length and a few hundred yards broad. The three towns are but a short distance from each other. Wál-pi, in some places four stories high, lies at the very west end of this mesa. The pueblo is compactly arranged with no outlying houses, although a few of the families have built houses in the plain below.

Si-tcúm-o-vi is a rambling pueblo in different quarters one and two stories high, enclosing a central plaza. Té′-wa or Hā′-no has, at the east end, a group of houses four stories high built around a projection of rock on the mesa top, and the quarter facing the south has two stories.

The second mesa is split into two parts upon one of which stands the village of Mi-cóñ-în-o-vi; on the other Ci-mó-pa-vi. Ci-páu-lo-vi, which also rises from the same mesa like a Saracen's castle, crowns the top of the conical elevation and is the most picturesque of the seven towns of the Tusayan. These three towns of the Middle or Second Mesa are placed at the angles of an irregular triangle, Ci-mó-pa-vi being separated from the part of the mesa on which the other two towns are situated by a deep valley entering from the southwest. The most distant of the seven pueblos from the railroad is O-rái-bi lying some fifteen miles beyond the Middle Mesa. This village is likewise perched on a table-land to the top of which the trails are very steep.

Wal-pi takes its name from its vicinity to a gap in the mesa, Té-wa from the racial affinities of the inhabitants, Mi-cóñ-în-o-vi from the two pinnacles which rise from the foot hills, and Ci-páu-lo-vi from the adjoining peach orchards. All the villages with the exception of Té-wa,[1] speak the same language, and although there are variations in certain of their manners and customs, they are in the main similar. The towns of the East Mesa are the best known, and O-rái-bi from its present (1891) hostile attitude is practically unexplored ground.

The foot race described in the present article is called the *Wā-wāc-kā-tci-nā*, and has twice been witnessed by the author. These races were so different from those which

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[1] I have already elsewhere called attention to the fact that there is a difference linguistically and otherwise between Té-wa and the other two towns on the East Mesa. The history of the ancestors of these Té-wans who settled among the Hopi, as far as their departure from their old home is concerned, is partially known, and at least the approximate time when they came into the country has been recorded. The problem concerning the mutual relations of the villages which especially concerns the ethnologist is an investigation of the mutual changes which have come to both peoples by the association in their isolated homes. Preserving as they do their own language it is but natural to suspect that they brought and kept alive many of their old customs. We know that the women at the present day for instance, dress differently from those of the Hopi women and there is more or less variation in many of their customs.

Of the ceremonials which the Te-wans have imported may possibly be mentioned the *Mu-cai zru*, or bison dance. An exhaustive comparison of the modification in their language with that of the Eastern Te-wans is yet to be made, and there is also a great field open for a study of their equivalents of the Hopi divinities. When that is accomplished we shall be in a fair way to take steps in the identification of Hopi divinities, with those of the more eastern pueblos. I have already made a beginning in this study but have not yet progressed far enough to make known my conclusions.

In a broader way we have still a more general problem presented by the pueblo life of Tusayan. It has long been claimed and generally accepted that these people are related to the Shoshonees. As to the justice of that relationship I do not know enough to express any opinion, but if the linguistic relationship is near, it is an important problem to trace out the relationship between their customs and those of the nomadic tribes of the same stock, and it becomes an interesting study to determine the amount of influence resulting from their adoption of the village habits. The field for research which here opens is of a most general character and of greatest inportance. Of the relationships with the Nahuatl, I shall speak in a future publication, for I am not yet prepared to say that the relationship is close, although there are several significant resemblances in ceremonials which call for more facts for solution.

take place at the time of the great ceremonials as the Snake, *Lā′-lā-kon-tì*, and Flute, that they merit a special description. Moreover as several *Kā-tci-nās*,[1] which I have not seen in any other celebration, take part in these, and as the name given it at least implies a mythological relationship, it seems appropriate as a contribution to our knowledge of the mythology of these Indians to devote a special article to a description of it.

The following pages contain an account of the main events in the *Wā-wāc-kā-tci-nā* with a description of some of the participants. The author finds it necessary as a first step in the interpretation of the complicated mythology of the Tusayan Indians to preface with similar simple descriptions an article which he has in preparation in the distant future, explanatory of all the important ceremonies.

This account of the *Kā-tci-nā* foot races therefore, which is one of a series,[2] must be used in a comparative way with others already published or to follow. He is not prepared, before more data have been collected to offer a satisfactory explanation of the various events which are described.

The first *Wā-wāc-kā-tci-nā* which was observed took place in Ha-no (Te-wa) on May 11th; the second in Si-

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[1]The term *Kā-tci-nā* is applied to a great number of mythologic and semi-mythologic personages although more strictly confined to certain masked dances which appear in the public celebration of many ceremonials. The different kinds of *Kā-tci-nās* are very numerous and their relations to each other in the Hopi Pantheon very complex. The majority of the *Kā-tci-nās* bear names of animals, as *Kwéy-wĕ* (wolf), *Kō-hó-ne* (chipmunk), *Ka-vā-ho* Spanish (horse), *Ho-nán-i*, (bear), but names of deities as *Dā′-wā* (sun), *O-mow-ûh* (clouds), and others, may also have the same designation. This complicated subject will be discussed later, and it is only necessary here to call attention to the fact that certain public dances like the participants are called *Kā-tci-nās*, from the presence of personifications of these beings. A modified term sometimes written "*Cā-chi-nā*" is widespread among the New Mexican pueblos, and is sometimes applied to a sacred dance among certain tribes.

[2]See *Journal of American Ethnology and Archæology*, *American Folklore Journal* and *American Anthropologist*.

tcúm-o-vi on May 17th. Although different *Kā-tci-nās* appeared, the events of the race in both are the same. The *Wā-wāc-kā-tci-nā* is more after the nature of a secular than a religious observance; although from its name and the personages who take part, we may regard it as connected with ceremonial observances.

The *Wā-wāc-kā-tci-nā* is a race in which the *Pai-ā-kya-mûh*,[1] *Tā-tcúk-ti* and certain *Kā-tci-nās* challenge the fleet-footed inhabitants of the pueblos to run for prizes. The winnings were always taken by the civilians, but if caught by the *Kā-tci-nā*, he pays the penalty by light or severe strokes of the yucca whips carried for that purpose by the opponents.

The two *Wā-wāc-kā-tci-nās* occurred within five days of each other, just before the first *Hu-mís-kā-tci-nā*, a sacred dance which was celebrated in several of the villages.

The first celebration of the *Wā-wāc-kā-tci-nā* was at Tewa and the participants prepared themselves in the recess of the cliff on the main trail about fifty feet below the edge of the mesa. They marched up to the plaza about sunset, bearing the prizes done up in blankets on their backs.

There were ten *Pai-ā-kya-mûh* (gluttons), and six *Kā-tci-nās*. The former wore on their heads long horns ornamented with corn husks, and girt with black stripes. Similar black stripes were painted on their body, face and

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[1]The reader will find a discussion of the different "priesthood fraternities" in the Tusayan villages, in my article on "Summer Ceremonials," *Journal of American Ethnology and Archæology*, Vol. II, No. I. The *Pai ā-kya-mûh* are clown gluttons who made fun during some of the sacred dances, and were from Te-wa. They belong to the priesthood called *Tcu ku-wymp-ki-ya*, one of whom carries in his belt a *Tcú-ku-mā-nā*, or stuffed water-wren. The *Tā-tcúk-ti* are also *Tcu-ku-wy'mp-ki-ya* but they wear cloth noseless helmets with knobs or sausage like appendages, great goggle eyes and protuberant mouth. Still another kind of *Tcu-ku-wy'mp-ki yas*, not represented in the *Wā-wāc* which I have here described, has yellow painted faces with black bars as elsewhere described.

arms. All were loaded down with great bundles of *pí-ki*,[1] bundles of corn and other eatables which had previously been brought to the dressing place or recess in the rocks, by the women. The *Kā-tci-nās* laid these bundles of food on blankets placed on the ground at the north end of the plaza, and stood in line facing the west as if challenging the spectators to race. After the *Kā-tci-nās* and *Pai-ā-kya-mûh* had deposited their prizes on the blanket, an old priest shouted to the spectators. One after another, young men accepted the invitation to race by walking to a position in front of the line of *Kā-tci-nās*, and at a signal raced across the plaza at the top of his speed pursued by a *Pai-ā-kya-mûh* or a *Kā-tci-na*. Only one pair, however, raced at a time, but, if the *Kā-tci-nās* overtook his opponent he struck him once across the body or legs with a yucca leaf which he held folded up in the right hand, tore his shirt from the body of his opponent, or cut off a lock of his hair.

The prizes were distributed to those who entered the lists by an old priest who directed the race. In one or two instances the *Kā-tci-nā* was able to overtake the runner entering against him ; in several, however, he was distanced, but in all cases whether overtaken or not the contestant received a prize. At the close of the race the yucca-wands

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[1] *Pí-ki* or paper bread is the national food, if that expression may be allowed, of all the pueblo people. This is a kind of corn bread which is fried on a flat stone under which fire is burning. The batter is spread upon the greased stone by the hand and as the *pí-ki* is fried, the thin wafer-like sheet is raised from the stone and deposited in a heap. It is then either folded in squares or rolled in bundles for consumption. The common kind is the color of the most of the wood work, but bright red striped and other colored *pí-ki* are made. Several rolls of variegated *pí-ki* tied together side by side are not uncommon sights hanging to the walls in dwelling rooms. At the time of the foot races here described there was a considerable quantity of red (stained with cockscomb flower) *pí-ki* among the prizes. On occasions of ceremonies variegated *pí-ki* is common, but the favorite dish at that time is a pudding or *pi kum-i*.

were taken from the hands of the participants by the priest who sprinkled meal on the *Kā-tci-nās* and *Ta-tcúk-ti*, and deposited the yucca wands in a *bā-hó-ki*[1] near the pueblo.

A second celebration of the *Wā-wāc-kā-tci-nā* took place on the eve of the *Hu-mis-kā-tci-nā*, four days after, at the village of *Si-tcúm-o-vi*[2]. This celebration closely resembled the first, but different personages were introduced. The *Tā-tcúk-ti* and *Kā-tci-nās* dressed themselves in the recess of the cliff under the *bā-hó-ki* between Wal-pi and Si-tcúm-o-vi. The race took place in the plaza of Si-tcúm-o-vi, the *Tā-tcúk-ti* standing at the east end near the row of houses at that place. *Tā-tcúk-ti* and *Kā-tci-nās* took part, but no *Pai-ā-kya-mûh* appeared as in the celebration at *Té-wa*.

The following personages were noted in the two races which were studied in the summer of 1891 at the East Mesa.

HU-HU-WUH.

Hü′-hü-wûh appeared in the *Wā-wāc-kā-tci-nā* at Té-wa. I have studied the mask (Pl. II, fig. 4) worn by him and also have in my collection a figurine (doll) of the same personage. From these and a photograph (Pl. I, fig. 1) taken during the performance, a good idea of his symbolism can be readily made out. The head of *Hü′-hü-wûh* was

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[1]A *bā-hó-ki* is a shrine in which feathered sticks called *bā′-hos* are deposited and around which certain ceremonials are performed by novices and others on certain occasions. Their form varies somewhat but they are ordinarily simple square or rectangular cairns of stone, often uncovered, in which often a curious waterworn botryoidal stone is placed. Simple heaps of stones dedicated to *Mā′-sau wûh* may often be termed *bā-hó ki*, and small cavities in boulders have the same designation. The *bā-ho-ki* in which certain offerings, as those of the "Farewell *Kā tci-nā*", are placed is a covered chamber and the flat slab over it may be luted in place after use with adobe.

[2]On the afternoon before the race the plaza was carefully swept in preparation. The celebration took place at a little before sundown before a large assemblage of spectators. Many of the racers, possibly all, were from the neighboring village of Wál-pi.

covered by a helmet, made of leather, and painted brick red. The hair of the helmet was a white skin. A prominent nose was represented and the eyebrows were outlined in a way very different from the same in sacred dance masks. The distinguishing marks of the helmet were two white lines, one on each side, extending from the nose across the cheeks broadening as they reached the edges of the mask.

The photograph of the man taking the part of *Hü'-hü-wûh* shows that he wore a ceremonial dance kilt and that the rest of his body was naked, with the exception of a fur about his neck and a scanty kilt. The body was, however, painted and decorated with parallel finger marks irregularly drawn over it. In the *Wā-wāc-Kā-tcí-nā*, *Hü-hü-wûh* is lame, and in the doll the legs are represented as crossed. He hobbled about during the race creating much fun and boisterous laughter by the spectators.

KE-SE-KA-TCI-NA.

Ke-se-kā-tcí-nā, the hawk *kā-tcí-nā*, also took part in the *Wā-wāc-kā-tcí-nā* of May 16th. The material at my disposal for a study of his symbolism and dress are two Kodak photographs (Pl. I, fig. 4) and notes made during the race. In the photograph, which is introduced in Plate I, it is seen that his helmet is covered with downy substance, probably white feathers, and the snout is protuberant. Around his neck there was a coarse cloth. His body was painted white and upon each upper arm he had a string of primary feathers in imitation of wings.

In the *Wā-wāc-kā-tcí-nā*, *Ke-se-Kā-tcí-nā* ran about from place to place with body crouched forward imitating the hawk, moving his arms as if they were wings.

Among the personages who took part in the racing *Kā-tcí-nā* at Ci-páu-o-vi, there was one of whom I did not get a

photograph but who was identified as the *Múng-wa* or Owl *Kā-tci-nā*. He wore a helmet not unlike that of the owl which I have seen in the *So-yó-him*[1], but I am doubtful whether it was really intended that he should represent this *Kā-tci-nā* or not.

There was still a second which I was also unable to identify. From the variations which occur in the race as performed in the different villages, it seems legitimate to conclude that the running *Kā-tci-nā* varies very greatly in different pueblos. It would be most interesting in a comparative way to study the *Wā-wāc-Kā-tci-nā* at O-rái-bi where it occurs, as I am informed by one of the Indians, and in which judging from their celebrations, would probably be of more primitive character.

There are several pictographs[2] which have been identified for me as pictures of the *Wā-wāc-Kā-tci-nā* which would seem to enlarge a number of mythological beings who take part in these races. The present article is therefore after the nature of a preliminary sketch to be supplemented later by a more extended account with explanations.

UTE-CE-E-KA-TCI-NA.

Ute-cĕ-ĕ or Apache *Kā-tci-nā* appeared in the *Wā′-wāc* with *Ke-se-kā-tci-nā* (May 16th). I have as material for the study of this character several photographs (Pl. I, fig. 2) taken in the *Hu-mis* dance and in the *Wā′-wāc* at Si-tcúm-o-vi, and have also examined the masks (Pl. II, figs. 2,3,4) which were in each ceremony.

The mask (Pl. II, fig. 1) is made of leather barely large enough to cover the face and is bent into shape to

[1]The *So-yó-him-Kā-tci-nā* dance, described in Vol. II, *Journal of American Ethnology and Archæology*, was witnessed in Ci-paú-lo-vi. In this ceremony many different *Kā-tci-nās* of many colors participated.

[2]See *American Anthropologist*, January, 1892.

cover the face. The nose with nostrils is represented in relief[1] and the lips are protuberant. The eyes are simple round holes, without ornaments or marks to represent eyebrows.

The mask is painted white with vertical parallel red lines extending the whole length of the face and along the middle line of the nose. The hair is stiff black horse hair which is tied to the upper rim of the mask and stands upright. The ornamentation of the face of a *Ute-cĕ-ē* mask (Pl. II, fig. 3), used in the *Hu-mis-Kā-tci-nā*, which I have examined, is somewhat different from that already described.

Like the above mentioned it is painted brick red, the nose and eyebrows being formed of pieces of leather of the same color affixed to it. Across the face on a level with the eyes is drawn a black band and radiating black marks are painted above the eye openings. A similar parallel black band and radiating black marks are painted above the eye openings. A similar parallel black band is painted from each corner of the mouth to the edge of the mask. Across the middle of the face and over the nose is painted a zigzag white band, with five parallel zigzag white bands on the chin.

The photographs (Pl. I, fig. 2) of *Ute-cĕ-ē-Kā-tci-nā* show that his body, arms, and legs are crossed by parallel lines made by drawing the fingers smeared with color over the skin. The photographs of *Ute-cĕ-ē-Kā-tci-nā* in the *Wā-wāc-kā-tci-nā* show that he wore a tight-fitting cap without a wig while in the *Hu-mis*, the same *Kā-tci-nā* has the long black horse hair unconfined.

Another mask (Pl. II, fig. 3) of the Apache *Kā-tci-nā* was much more complicated than either of those which we have described, but like the former, the face was painted

[1]The nose of the pot helmets used in *Kā-tci-nā* dances is rarely if ever represented.

brick red. The mask was made of leather and crossed by two parallel zigzag lines in white over the nose and by two similar zigzag lines not parallel upon the eyebrows. A black mark extended from the corners of the mouth to the edge of the jaws, and a similar black line from the eyes to the ears parallel with the first. On the upper part of the head there was a dentated crown in white upon a black ground, and on the back of the helmet there were symbolic crosses representing the star god *Co-tü′k-i-nung* and two serpents. This helmet was much more complicated than the other two which we have described and is a much more elaborate piece of work. Portions of the back of the helmets were made of an old felt hat, but the mask was of leather.

HO-NAN-KA-TCI-NA.

Among the participants is the *Wā-wāc* at Te-wa was a man dressed in a rabbit robe, who wore on his head a rounded helmet with protuberant snout. He carried in his hand a stick at the end of which was tied a branch of cactus, with which he went from one to another of the spectators paying his attention especially to the women, girls and boys, driving them from their seats in the plaza with this spiny implement. This *Kā-tci-nā* was decorated with the symbol of the bear *Hó-nan-i*, a figure representing the imprint of the bear's claw and on that account has been identified as the Bear *Kā-tci-nā*.

CHE-KA-NA.

During the *Wā-wac* at Si-tcúm-o-vi, two persons wearing the helmet of *Che-kā′-nā* took part. I have examined the helmets worn by them but did not succeed in getting good photographs. The helmets are painted brown on one side of the face and green on the other, the eye openings having rows of dots above them. From my notes I find that the bodies of these persons were painted in two colors.

A single personage wearing the *Ley'-to-to-bĕ*? mask also appeared in the same *Wā-wāc*. The helmet was painted black with a red band across the eyes. A boy called *Tā-cā'-bĕ*, Navajo, wearing a mask not unlike that of *Ute-cĕ-ĕ* appeared in the same *Wā'-wāc*, but he took a very subordinate part in the race.

TA-TCUK-TI.[1]

The largest number of participants in the *Wā-wāc-kā-tcí-nā* at Si-tcúm-o-vi were the *Tā-tcúk-ti*[2] or knobbed-headed priests who play an important part as clowns in the Tusayan sacred dances. The *Tā-tcúk-ti* were naked with the exception of a simple cloth about their loins and the helmet coverings of their heads. Appended to the sides of the close-fitting cloth helmets there were several knobs filled with seeds, or long sausage-like appendages hanging down the cheeks from either side.

The bodies of the knobbed-headed priests were marked with lines drawn by the fingers on the mud with which they are smeared and their feet are without moccasins. *Tā-tcúk-ti* ordinarily stood (Pl. I, fig. 3) in line back of the piles of prizes spread out on the blanket on the ground and armed with a yucca leaf. While awaiting the beginning of the race this leaf is closely folded in the hand and it is only when they have overtaken their contestants that this whip is unfolded and used in striking the legs and back of the luckless individuals whom they overtake in the race.

PAI-A-KYA-MUH.

These personages have already been described and figured elsewhere.[3] They wear a closely fitting skull cap upon

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[1]Sometimes the first syllable is reduplicated, *Tā-tā-tcúk-ti*.
[2]From *Tā-tci*, a knob, referring to the knobbed helmets which they wear, or from a verb meaning to leap up or jump.
[3]*Journal of Am. Ethnology and Archæology*, Vol. II, No. 1.

which are two horns girt with alternate white and black bands, and bearing a few corn husks at the top and base. The cap is likewise girt with black and white bands and both of the same colors are painted on their bodies, arms and legs.

They are Tewan members of the *Tcu-kú-wy'mp-ki-ya* and from their actions in dances may very properly be called gluttons. The same personages have been photographed by me in Wál-pi sacred dances, and I have a doll of a *Pai-ā-kya-mûh* which has most of the symbolic marks mentioned above. As *Tcu-ku-wy'mp-ki-ya* to which group of priests the *Tā-tcúk-ti* likewise belong, these men very properly figure in the *Wa-wac-kā-tci-nā.*

Among the many masks and helmets which one sees by searching in the hidden rooms of the villages I have found several which have been referred to the *Wā-wāc-kā-tci-nā*, and I suspect that from time to time other characters besides those described also take part in the races which have been described. One of the most characteristic of these masks is said to be that of *Hém-i-cow.* The helmet of *Hém-i-cow* which I observed in the *Al-kib-va*[1] at Wál-pi is unlike any other with which I am familiar. It is of cylindrical shape and painted black with green, yellow,

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[1] The so-called kib-vas are subterranean chambers built in crevices in the rocks and are used in the performance of the secret portions of religious ceremonials. Of these there are five at *Wál-pi*, two in Si-tcúm-o-vi, and two in Tewa. The *A'l-kib-va* is one of the smallest of these and is situated on the dance plaza at Wál-pi. It is, however, one of the important kib-vas and in it are performed the ceremonies of the *Mám-zrau-ti* (a woman dance in September, see *Amer. Anthropologist*, July, 1892.)

The kib-vas are ordinarily used as gathering places for the men and in them many blankets are woven. Although it is not customary for the Indians not engaged in any ceremony, to enter the kib-vas, we were always permitted free entrance, with one or two exceptions. I have given elsewhere an account of the more important architectural details of the kib-vas and their orientation, and the Al-kib-va is not in any respects characteristic. The *A'l-kib-va* is the kib-va of the Horn men or Horn priests, and in the *Nā-āc-nai-yā* it is the place of the ceremonies of the warrior fraternities.

red, and white bands around the upper rim. From these bands depend other lines or bands painted in the same colors, a medial band being red and those on either side yellow, white and green. Above the round orifices marking the position of the eyes there was tied a small fragment of pith, the signification of which is unknown to me. The mouth is duck-bill shaped not unlike that so common among the *Kā-tci-nās*.

In order to show how the race which has been described differs from the ordinary running races which accompany the great celebrations in the Hopi calendar, let us take for illustration that performed on the morning of the ninth day in the *Lā′-lā-kon-tì*.[1] This race differs in details from that of the Flute, the Snake and the *Nimán-kā-tci-nā*, but has several points in common with them; so that, looking at their relationship in a broad way, we may say that their common features show the general character of the races which accompany the great ceremonials.

The races in the festival mentioned always take place from the plain or the foot hills up the mesa trails, although the limits of the race are two points in the plain or in the foot hills. The termination of the race is not limited nor do the contestants stop running until they enter the village on the top of the mesa. In certain of these the final ceremony connected with the race takes place in the underground kib-va where the rites of the particular festival are celebrated.

The man who stands at the terminal goal of the race is a priest dressed in appropriate costume holding a crooked stick in his hand. He makes upon the trail, near which he stands, in sacred meal, the symbol of the rain cloud. As the racers approach they pass over these figures and

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[1] For description of the *Lā′ lā-kon-tì* see *American Anthropologist*, April, 1892.

touch the crook which he holds, with the palm of their hands. In the case of the *Lā′-lā-kon-tì* in which a girl races with the men, this girl is placed within a circle of meal upon the trail and near her is deposited prayer sticks called *bā′-hos.* The crook which the priest holds is deposited after the race in a shrine and sometimes brought to the kib-va. In the *Lā′-lā-kon-tì* the former deposition is made, and in the Snake and Flute races the latter, but in all instances the contestants are compelled to run up the hillside before the race is finished.

In none of the races up the trail which I have witnessed did the clowns or *Kā-tci-nās* take part. It will be seen from my account[1] of these races that there is no close relationship between them and the *Wā-wāc-kā-tci-nā.* The winners are not given prizes nor do the participants flog each other with yucca wands. Of all the foot races which I have seen the *Wā-wāc-kā-tci-nā* is unique in its character. I have not referred to the meaning of the *Wā-wāc-kā-tci-nā*, although from its character and the participants who take part, there can be no doubt but that it reaches back to the early history of the people.

One is tempted to regard the *Wā-wāc* as the same as the spring races which have been described in the Rio Grande pueblo, but the exact relationship is not wholly clear to me. The presence of the *Kā-tci-nā* is an important element which will be spoken of in a later publication in which comparative accounts of the two will be considered.

It is said that the prize in the Snake race is the greatest of all prizes attainable, namely, long life and all the blessings which come to men, but however this may be, the

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[1] *Journal of American Ethnology and Archæology*, Vol. II, p. 1.

winner of the Snake race is a marked person. The so-called Snake race which occurs on the morning of the ninth day of the Snake Antelope ceremony before dawn is traditional and like so many other ceremonial customs is said to date back to the infancy of the people. Bourke in his work on the Snake dance has called attention to ancient races in Mexico up the Teocalli or pyramids and the fact that the runners in a Snake race do not stop before they arrive at the top of the mesa. The thought is a suggestive one and will be considered elsewhere.

The *Wā-wāc-kā-tci-nā* also occurs in certain proceedings which take place on the afternoon of several of the *Kā-tci-nā* dances. I have already elsewhere described the antics of the *Tā-tcúk-ti* and certain *Kā-tci-nās* while the sacred dances[1] are taking place. These personages endeavor in every way to amuse the spectators both in the intervals between the dances and while the latter are progressing. These antics consist of puns, inordinate eating, indignities to each other and curious or grotesque situations in which they are placed. I have recounted some of these in my notice of the summer ceremonials and have likewise witnessed the *Wā-wāc-Kā-tci-nā* in sacred dances here performed by the *Tā-tcúk-ti* and others dressed as *Kā-tci-nās* who come in for that purpose. These *Kā-tci-nās* were different from those taking part in the sacred dance and were generally personified Apaches or Navajos or certain phallic societies. This fact is significant when taken in connection with that known from the descriptions above where the Apache personification is so little known. Although these Apache *Kā-tci-nās* are not the only ones who take part in the exercises we are

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[1]See *Hu-mis, Kā-tci-na, Mā-lo-Kā-tci'-nā, etc.* (Journ. Amer. Eth. & Arch., Vol. II)

about to describe, they were present in several characteristic performances which I have noticed. One of the most interesting of these is the dance of the *Tcu-kú-wymp-ki-ya.* While the dance of the *Kā-tci-nā* was taking place in the celebration of the *Humis-kā-tci-nā* a blanket were laid down near the west end of the line and upon this was placed bundles of corn, *Pí-ki* or paper bread, and food of all kinds. Behind this, facing it, the *Pai-ā-kya-mŭh* were seated in line and to each was given one of the bundles as a gift. The men personifying Apaches, of whom there were two, then caused one of these to rise and led him to the extreme east end of the line of dancers who were meanwhile singing and performing their dance. Each *Tcu-kú-wymp-ki-ya* was forced to dance and to tell a story in payment for his gift.

When the glutton had been carried to the east end of the line he was stopped, turned around and addressed or commanded by the Apaches who raised their horsewhips or "quirts" in a threatening manner. Moving a few steps in a sidelong manner, the gluttoned followed by the Apaches performed an archaic dance saying, "*A-e, A-e.*" At a word from his tormentors he started again moving a few feet with an awkward, sidelong, halting gait and stopped again. As he did this, he again began his story, calling down laughter from the spectators. This was repeated again and again often urged forward by strokes from the whips of his tormentors until he reached the pile of corn in front of his comrades. A second member of the line, squatting back of the corn was then treated in the same way, and the same series of halts, shouts and jokes were repeated. All the gluttons were forced through this performance causing much merriment from the lookers-on. The whole effect was simply to amuse the people, and if it

is a modified dance it has certainly degenerated into a ludicrous performance.[1]

I have witnessed the same or a similar thing at the village of Ci-pàu-o-vi during the dance of the *Mā-lo-kā-tci-ñā*, the only difference being that instead of the *Pai-ā-kya-mûh*, the *Tā-tcúk-ti* were the sufferers. There were at that village several persons taking part, who wore Navajo or Apache masks. They carried ancient leather shields ornamented with crosses and other figures of a symbolic significance. In the same celebration a person appeared wearing the Owl *Kā-tci-nā* mask. I have likewise seen *Má-sau-wûh*, the death god, personified in the *Wá-wac*, a hideous personage wearing about his loins for a belt the intestines of a dog recently killed, the face and body smeared with fresh blood.

One is tempted to regard these antics of the clowns and the Navajos and Apaches as burlesques of races introduced during the solemn dances, but if such is the explanation this portion of the dances is highly modified and come to be regarded as an opportunity to introduce local allusions and modifications which cannot be regarded in the same light as the dances themselves. Consequently, the events which occur at that time, in which the clowns participate, should not be regarded as necessarily related to the historic ceremonies.[2]

Much is left to individual invention of the clowns to render their part more striking and it is not rare to see

[1]In most instances the stories told by the gluttons for the amusement of the spectators were obscene but not always so. On one occasion one of the younger gluttons when forced to tell a story recounted the improvements which the people were making in late years, a suggestive ray of light on the otherwise sombre background of primitive savagery.

[2]It has been suggested that the introduction, for instance, at this time, of a colored soldier is of ancient date, but it is undoubtedly not older than the employment of negro soldiers in the army of the United States.

them introduce personifications of events which occur during the summer. The existence of this curious modified performance, by which the Navajo force the gluttons to run and their refusal with many objections may, however, be of ancient origin.

The introduction of such personages as *Ute-cĕ-ĕ* (Apache) and *Tā-cāb-kā-tci-nā* by the Hopi in their sacred dances is an interesting fact. It must be borne in mind that the village Indians of Tusayan have had frequent wars with these tribes, often of most bloody character. I have been shown a cleft in the East Mesa near precipitous cliffs at the west end, where the dead, in one of their wars with the cruel Apaches, were buried, and I have been told of a certain struggle with them in which the hearts of the dead Apaches were given to the Hopi women (the unmarried women were especially mentioned) to eat, in order that their children, Hopi warriors, might be brave against their enemies. This story was told me on good authority and, in a comparative way, one has no reason to doubt its possibility.

Notwithstanding, however, this traditional hatred in the Hopi mind against the Apache and Navajo the villagers have introduced an Apache *Kā-tci-nā* in the *Wā-wāc-kā-tci-nā*, while in the *So-yó-him* a sacred *Kā-tci-nā* dance a personage called the *Tā-cāb* (Navajo) is prominent. This incorporation of foreign *Kā-tci-nās* is suggestive. We can readily see a good reason for the introduction of *Kā-tci-nās* from the Zuñis, but it might seem strange that others should be derived from enemies. The way the Hopi regard this question may, however, be summed up in a liberal statement expressed by An-a-wí-ta, viz. :—that it is wrong to speak of *Kā-tci-nās* as Zuñi or as Hopi. The *Kā-tci-nās* are without nationality, "they are for all," but

certain peoples preserve the cult of individual *Kā-tci-nās* better than others. In following the lead of those who best know any particular *Kā-tci-nā*, no element of hostility should play any part. It might readily be concluded that as far as the gods are concerned, the Indian is prepared to be taught by any one who has valuable knowledge of the *Kā-tci-nās*. I do not affirm that the Hopi so regard this question or that this is their reason for the introduction of strange *Kā-tci-nās*, but I so interpret the few remarks which I have heard on this point.

Tā-cāb-kā-tci-nā ordinarily wears a helmet with a band across his face not unlike that of *Hü'-hü-wûh*. On the dolls of *Tā-cāb-kā-tci-nā* which I have, some specimens have the same marks painted in different colors but in several they are absent altogether. I shall discuss this question more at length in my article on Hopi figurines (dolls).

In interpretations of the meaning of Hopi ceremonies, personages and paraphernalia which appear in the same, a strict line of demarcation must be drawn between possible and real explanations. The nature of the subject is such as to invite one to speculation. The explanation built on the testimony of priests is good as far as it goes but even this is not always final. Human nature is fallible and while a priest may report the explanation which he has heard from his antecedent in office, the element of invention and mistake in transmission from generation to generation must always be taken into account in a final estimation of the subject. Although the explanations advanced by the priest to explain ceremonies and personages which occur in such is capable of scientific treatment, they cannot be regarded as exact knowledge or science, but must be used for what they are worth. That the priests believe that the crooks about the altar and the fetiches of

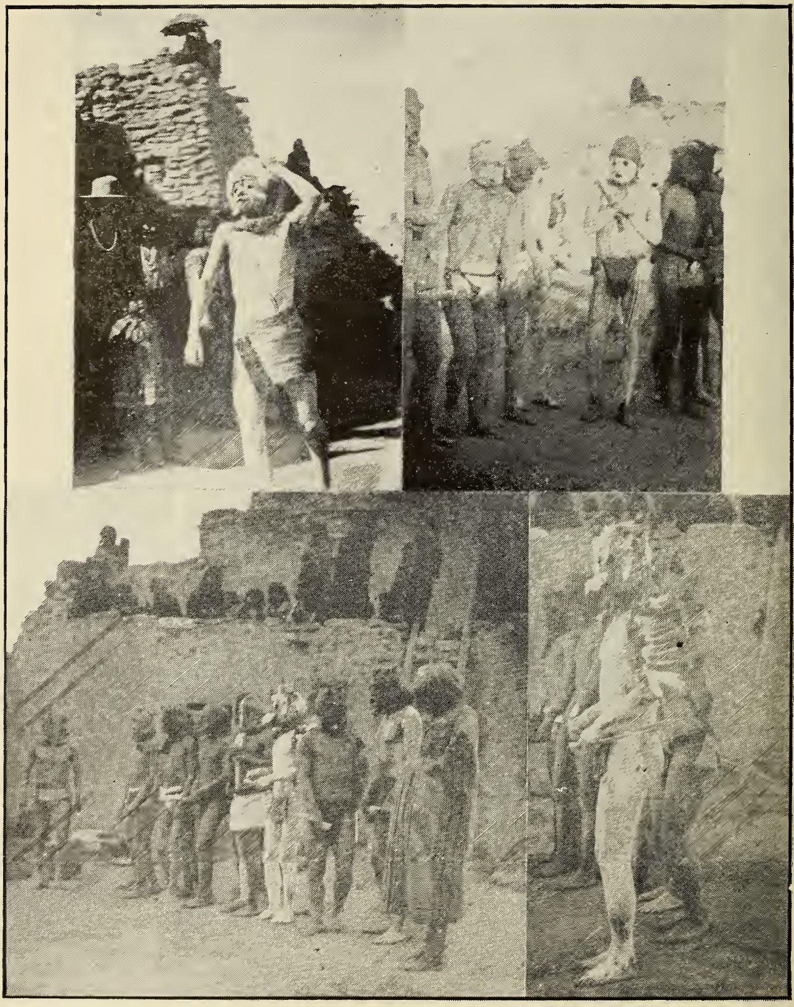
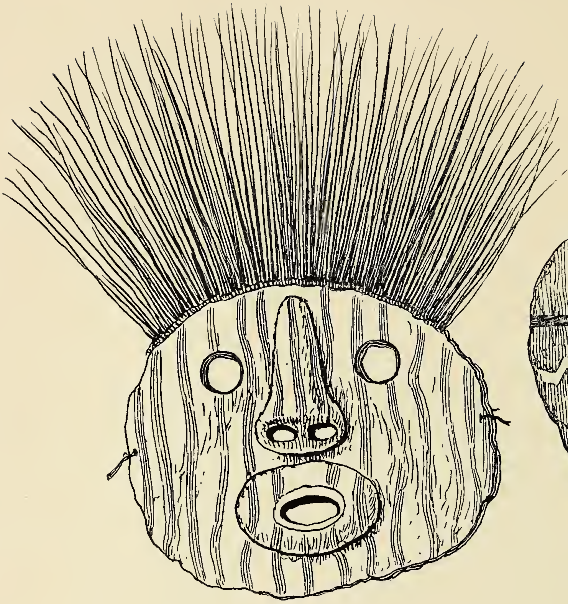


PLATE I.



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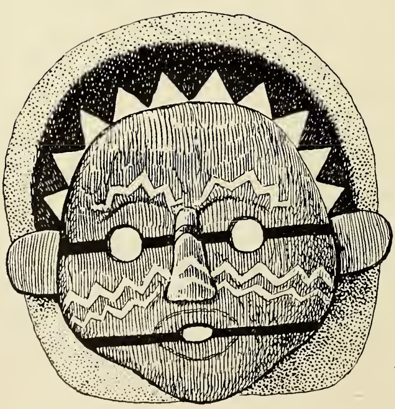

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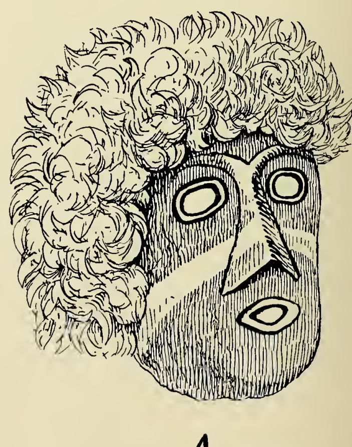

4.

PLATE II.

the same in the Snake Ceremony were brought up from the underworld,[1] or certain explanations of why certain ceremonials are performed have been handed down from the ancients, no one can doubt. But human invention has been fertile through that lapse of time and local coloring has modified the explanations until it may have lost much of its original value. It is more than we can expect that the priests officiating in a ceremony can give other than a traditional explanation. His testimony is a valuable contribution to an understanding of local modifications, but the question is too great for him to answer. The insidious influence which leads the observer to enlarge upon possible explanations suggested by priests who may have received their explanations must be carefully controlled, otherwise folk-lore becomes useless as a scientific contribution. At most the explanation given by priests is only one means to bring to a solution of the question of the meaning of religious ceremonials and its limitation should be properly recognized.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Hŭ-hŭ-wuh.*
Fig. 2. *Ute-cĕ-ĕ-kā-tci-nā.*
Fig. 3. Line of *Tā-tcuk-ti* with priest awaiting the contestants in the race.
Fig. 4. *Ke-se-kā-tci-nā.*

PLATE II.

Fig. 1. Mask of *Ute-cĕ-ĕ* used in the *Hu-mĭs-kā-tcĭ-nā.*
Fig. 2. " " *Ute-cĕ-ĕ.*
Fig. 3. " " *Ute-cĕ-ĕ* from the kib-va, not observed to be worn in the race or in a dance.
Fig. 4. Mask of *Hu'-hu-wuh.*

[1]The Hopi, in common with some other pueblo people, believe that men came upon the surface of the earth crawling out of an opening near the San Juan river, and called *Si-pā-pu.* The Tusayan Tewans claim that they did not issue from the same *Si-pā-p u* as the Hopi but from another in the far east, which they call *Si-p'o-p'o-nĕ.*

ANNALS OF THE SEA SERPENT.

A "SEA SERPENT."

The appearance in Gloucester (Cape-Ann) harbor of an uncommon *Sea Animal* has been the topic of conversation and wonderment for several days past. A number of gentlemen of information and veracity have asserted, that they have seen such an animal off and in that harbor, reposing at times on a smooth sea, and had thereby an opportunity to see and judge of its form and dimensions. Their accounts, though in some instances dissimilar, all agree that this animal is of the species called the *Sea Serpent.* It is described as having its head (like those given to serpents in prints) at times, out of water; that to some it appeared as large as the head of a horse—to others, varying, perhaps, according to distance, as that of a large dog;—that its body was round like a snake's, but connected by joints, which to some appeared like a row of ten-gallon kegs, and to others like barrels; that its length was estimated by some to be 40 feet, by others 30, 100, and over; that its motion was serpentile, erratic, and rapid for an animal of its bulk; that it has been seen lying on the surface of the water, with parts of its body from six to eighteen inches out of the water, and its tail nearly on a line with its head; that it frequently forms circles in its movements, and in its progress sometimes leaves a wake of a mile in length.

Measures have been taken, and others are contemplated,

for killing and exhibiting this animal. It is hoped they will succeed. The *Encyclopedists* have doubted the existence of such animals as *Sea Serpents*, which have been described by some navigators, particularly by Egede as frequenting the Greenland seas some of which have been described as extending its head as high as the main-top-mast of a ship, its body being as thick as a hogshead, its skin variegated like a tortoise shell, and its excrement corrosive.

The *Salem Gazette* of yesterday says, " We are informed, that on Sunday this creature was seen playing sometimes within 15 or 20 feet of the shore, affording a better opportunity to observe him than had before occurred. Gentlemen from Gloucester state, that he appeared to them of an even greater magnitude than had before been represented, and should judge from their own observation, that he was as much as 150 feet in length, and as big round as a barrel. They saw him open an enormous mouth, and are of opinion that he is cased in shell. The chance for taking or killing this creature seems to be small; it requires not merely the club of a *Hercules*, but the cunning contrivance of a *Vulcan*. We understand, however, that it is proposed to make a number of strong nets, in the hope of entangling and embarrassing him, so as to be able to get him into a situation to kill him; in which we rather wish than expect they may prove successful."

Corroboration. Capt. Obear, who has arrived at Beverly, reports, that on Sunday last he put into Cape-Ann harbor, where he and his crew were astonished at the sight of a monstrous creature lying upon the water, which appeared to have the form of a serpent.

Whatever doubts may have existed on this subject, there are hundreds who can testify to the existence of some creature of a very uncommon bulk and form, and such as was never before seen upon our coast.

The bold adventurers (says the *Salem Gazette*) who are fishing for the Sea-Monster at Cape-Ann, ought to be furnished with the implements mentioned in the following lines :—

"THE GIANT ANGLING."

"His angle-rod made of a sturdy Oak,
His line a Cable that in storms ne'er broke;
His hook he baited with a Dragon's tail,
And sat upon a rock and bobb'd for whale."

Boston Centinel, Aug. 20, 1817.

IMMENSE SEA SERPENT.

(A FISH STORY.)

A species of Sea-Serpent was thrown on shore near Bombay in 1819. It was about forty feet long, and must have weighed many tons. A violent gale of wind threw it high above the reach of ordinary tides, in which situation it took nine months to rot; during which process travellers were obliged to change the direction of the road for nearly a quarter of a mile, to avoid the offensive effluvia.

It rotted so completely that not a vestige of bone remained. (From 10,000 Wonderful things, by Edmund F. King, London.)

The *Massachusetts Gazette*, Sept. 26, 1784, says—"Captain Wyatt of the ship Whale writes to his friends in London, that he has been within a few leagues of the North Pole; and that at the Pole there was a most dreadful eruption of nitre, which proved there was a volcano. Crystallized substance, like glass fell near Capt. Wyatt, which refracted the light; by this he accounts for the *Aurora Borealis*.

BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 24. Salem: Oct., Nov., Dec., 1892. Nos. 10, 11, 12.

Annual Meeting, May 18, 1892.

The annual meeting was held in Plummer Hall, this evening, at 7.30 o'clock; Vice President A. C. Goodell, jr., in the chair. The record of the last annual meeting was read by the Secretary.

The reports of the Secretary, Treasurer, Auditor, Librarian, and the Publication Committee were read, accepted and ordered to be placed on file.

The report of the committee on nominations was presented by Geo. M. Whipple, and it was

Voted, to proceed to the election of officers for the ensuing year. Messrs. Phippen, Morse and Welch were appointed by the chair to distribute, collect, assort and count votes. This committee reported the following list of names as receiving all the ballots, and these officers were declared unanimously elected:

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

Abner C. Goodell, Jr., Daniel B. Hagar,
Frederic W. Putnam, Robert S. Rantoul.

SECRETARY:

Henry M. Brooks,

TREASURER:

William O. Chapman.

AUDITOR:

Geo. D. Phippen.

LIBRARIAN:

Charles S. Osgood.

COUNCIL:

William H. Gove,
Thomas F. Hunt,
David M. Little,
Richard C. Manning,
Edward S. Morse,
S. Endicott Peabody,
David Pingree,
Edmund B. Willson,
George M. Whipple,
Alden P. White.

Report of the Secretary.

Since the last annual meeting there have been twenty-two meetings of the society and two meetings of directors.

There have been two field meetings during the last season, one at Bartholomew's Pond, South Peabody, July 1, 1891. About thirty persons attended this meeting. Vice President Hagar presided, and after a few introductory remarks introduced Mr. John H. Sears, who spoke of the plants of the region, and Mr. Cyrus M. Tracy of Lynn, who made some remarks on the flora of the vicinity. The speakers were interesting and instructive, and the meeting, though a small one, was enjoyed by all who took part in it. The second meeting was on Wednesday, September 16, at Bradford Academy, where some thirty persons con-

nected with the Institute, by invitation, dined with the venerable President, the teachers and the members of the senior class of the Academy. Vice President Hagar presided at the meeting, and remarks were made by Dr. Cogswell, Prof. E. S. Morse, John Robinson, Esq., John H. Sears, Esq., and others. The day was fine and all who participated in the meeting were much pleased.

During the past season papers have been read before the society, in Plummer Hall, by the following persons:

Wm. A. Mowry, Esq., on "U. S. Boundaries and Boundary Commissions."

A. A. Post, Esq., of Boston, on "Volapuk."

Rev. G. T. Flanders, D.D., on "Our Aryan Ancestors."

Rev. Joseph Kimball, of Andover, on "Arts: Present and Future."

Prof. Edw. S. Morse, on "Japanese Pottery."

Sidney Perley, Esq., on "Prehistoric America."

Mr. J. Walter Fewkes, of Boston, on "Study of an Aboriginal Ceremonial."[1]

Rev. A. P. Putnam, D.D., of Concord, on "Wenham Lake Ice Co."

Sylvester Baxter, Esq., of Boston, on "Municipal Democracy."

Col. Henry Stone, of South Boston, on "General Sherman."

Rev. E. O. Dyer, of South Braintree, on "Coligny and the Huguenots."

Dr. J. E. Wolff, of Cambridge, on "The History of Rocks learned by the Microscope"—with lantern illustrations.

Dr. P. C. Knapp, of Boston, on "Hypnotism."

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[1]See Bull. Essex Inst. Vol. XXIV, p. 113.

Hon. Alden P. White, of Danvers, Readings from Tennyson.

Ezra D. Hines, Esq., of Danvers, on "A Day at Lexington."

All these lectures have been well attended.

On the 29th of February, the 200th anniversary of the Witchcraft delusion in Salem (in February, 1692) a meeting was held by this society in Academy Hall where there was a very large and interested audience present. Upon the stage were Prof. D. B. Hagar, Prof. E. S. Morse, Rev. C. B. Rice of Danvers, Mayor Rantoul, Prof. Barrett Wendell of Harvard College, Hon. A. C. Goodell, jr., W. S. Nevins, Esq., Rev. Dr. A. P. Putnam of Concord, Wm. A. Mowry, Esq., of Salem, Ross Turner, Esq., and the Hon. Chas. S. Osgood.

Mr. Nevins called the meeting to order, read the warrant for the arrest of Sarah Good, Feb. 29, 1692, and in a few remarks introduced the Mayor of the city, as the Chairman of the meeting. Addresses were delivered by Professor Wendell, Rev. Mr. Rice, Mr. Goodell and Mr. Mowry. The meeting was considered a decided success. The *Evening News* said—"The audience was an intelligent and interesting body," and that all the speakers had given the subject a careful study.

All the lectures have been free to the public and it is believed have given satisfaction. Reports were printed in the Salem papers.

There have been 686 donations to the cabinets, from 135 different donors the past year. These donations have been acknowledged through the mail and in the *Salem Gazette*.

More than 7300 persons have visited the old meeting house of the First Church, and the question "How did they

get up in the gallery?" has been answered at least 5,000 times the past year.

Thirty-three persons have joined the society during the year, and seventeen members have died, viz.:

Augustus S. Browne,	George Roundy of Beverly,
Rufus B. Gifford,	John H. Silsbee,
Nathaniel A. Horton,	Frank Stone,
Catherine K. Ireson,	Stephen G. Wheatland,
George R. Lord,	Cyrus M. Tracy of Lynn,
George B. Loring,	James D. Waters,
Martha A. Nichols,	Charles Woodbury,
George Peabody,	Martha A. Willson,

John Webster.

In the historical department the collections are continually increasing, and I can now only repeat in substance what was said last year on this point.

Additions to our building and funds are greatly needed to make a proper display of the important donations to the cabinets and to arrange and catalogue the manuscripts.

It is desired that the members generally will help us at least to increase our membership, which can be easily done if the matter should be taken hold of earnestly. If, for instance, every member should feel it incumbent on himself or herself to obtain for us two new members in the coming year, it would be a very great aid to us and help to "bridge over" to the time, when it is hoped some one or more of our friends will contribute a hundred thousand dollars to the funds of the society.

The Institute is also in need of more young persons, of both sexes, for members, and especially those who would be interested in our work and would aid us in arranging the various collections. Of course we want old people too, but no society can long exist without the coöp-

eration of the young and enthusiastic. It might reasonably be supposed that for the credit of Salem if for no other reason, the young would come forward and beg to assist in the work of the Institute.

On the 9th day of January last, a committee, consisting of Mayor Rantoul, Ross Turner, D. B. Hagar, David M. Little, W. S. Nevins, Francis H. Lee, John Robinson, Eben Putnam, Thomas F. Hunt and the secretary, was chosen by the society to arrange for an exhibit of the Institute at the great Exposition to be held in Chicago next year. This committee has held several meetings and has formulated a plan which when carried out will ensure such a representation of the society at this Columbian Exposition, as will redound to its credit, and also to that of the city and county. The committee has arranged to have this exhibit placed in the main reception room of the Massachusetts Building, and the committee is empowered to form a general committee, which shall take charge of the whole matter of raising the necessary funds and attending to the numerous details which such a work requires. The full report of this committee will be presented to the society when plans are somewhat farther arranged.

A special committee consisting of Messrs. Turner, Nevins and Morse was appointed on the 11th day of last January, to take charge of the Witchcraft meeting on the 29th of February, and as that meeting was only preliminary to the erecting of a Memorial to the victims of the delusion, the committee will probably report at a meeting of the society a plan looking towards the carrying out of this idea to a successful termination. Much interest has been shown in it especially by other historical societies and students.

During the month of November last, an exhibit of Water

Colors by Misses Emily P. Mann, Sarah S. Kimball and Mary M. Brooks, and Messrs. Arthur W. Dow, Dwight Blaney and Ross Turner, was held in the rooms of the society. It was opened free to the public, the attendance was very good, and the exhibit received much favorable notice. I would suggest that during the summer months it would perhaps be well to utilize Plummer Hall for a water-color exhibition, so many people visit our town during these months that it might be made an additional attraction.

During last season the Institute entertained many parties from kindred and other societies including the Rhode Island Historical Society, the Massachusetts Library Club, classes from Bradford and other schools, etc., and already this season a desire to visit Salem is shown on the part of one or two historical societies. These visits are very helpful, not only in the way of getting our members acquainted with those from other states who are engaged in the same work, but also obliging us to keep somewhat well posted in the history of our own town in order to answer properly the questions that are asked in regard to the different historical sites, etc.

I have so often suggested that the Institute would like to receive anything and everything of historical value, that I am sure you would hardly consider my report complete without again calling your attention to this matter. I want to see this collection grow to such an extent that an entire new building will be needed to display it properly, and I wish we had the building now and the funds to support it, for we need a handsome endowment to carry on the work of the society as it should be done.

Respectfully submitted,

HENRY M. BROOKS,

Secretary.

REPORT OF THE LIBRARIAN.

The additions to the library for the year (May, 1891 to May, 1892) have been as follows:

By Donation.

Folios,	45
Quartos,	186
Octavos,	1,058
Twelvemos,	346
Sixteenmos,	306
Twenty-fourmos,	106
Total of bound volumes,	2,047
Pamphlets and serials,	8,041
Total of donations,	10,088

By Exchange.

Folios,	10
Quartos,	16
Octavos,	142
Twelvemos,	61
Sixteenmos,	30
Twenty-fourmos,	22
Total of bound volumes,	281
Pamphlets and serials.	2,728
Total of exchanges,	3,009

By Purchase.

Folios,	4
Quartos,	29
Octavos,	139
Twelvemos,	53
Sixteenmos,	24
Twenty-fourmos,	45
Total of bound volumes,	294
Pamphlets and serials,	939
Total of purchases,	1,233
Total of donations,	10,088
Total of exchanges,	3,009
Total of purchases,	1,233
Total of additions,	14,330

Of the total number of pamphlets and serials, 4,396 were pamphlets and 7,311 were serials.

The donations to the library for the year have been received from one hundred and seventy-one individuals and

ninety-eight societies and governmental departments. The exchanges from eleven individuals and one hundred and seventy-four societies and incorporated institutions, of which ninety-one are foreign; also from editors and publishers.

The largest donation has been that of Dr. Wheatland's scientific library numbering over four hundred volumes.

The set of Littell's Living Age is now complete to August, 1891, and the set of Scribner's Monthly lacks only three numbers.

The librarian in presenting these statistics congratulates the members of the Essex Institute on the growing value of the library in all its reference departments. The Public Library and Athenæum furnish the popular books for general circulation, while the Institute aims to build up a large and valuable reference library. Here should be found the many books of little interest to the casual reader, but sometimes of inestimable value in the prosecution of certain lines of study and research. The pleasant rooms of the Institute are always open to students and investigators in any branch of literature or science, as well as to the general reader, and every assistance is given them in the prosecution of their work. So far as possible the books are arranged in the different rooms by subject, but there is great need of a catalogue or finding list so that it can be readily ascertained what books are in the library relating to any special subject. Some work has been done in this direction but the lack of funds prevents its being pushed forward as rapidly as it should be.

The growth of the library brings each year more sharply to our attention the need of additional room for the storage of books. This want will have to be met in some way in the near future and all action should be taken with this end in view.

A quiet and uneventful, although a useful and prosperous year for the library leaves little to be said in the annual report. The influence of the Institute broadens, and its work is appreciated more and more as the years go by. Let us see to it that there is no halt in its progress.

CHAS. S. OSGOOD,
Librarian.

TREASURER'S REPORT.

Receipts and expenditures of the past year (condensed from the account presented).

RECEIPTS

Balance of last year's account,		$10,557 96
Discount of note,	$2,500 00	
Interest from Five Cents Savings Bank to be funded,	58 66	$2,558 66
Assessment of members,	$774 00	
Income of invested funds,	3,589 07	
Sale of publications,	889 51	
Amounts received from other sources,	140 13	
Net income,		$5,392 71
		$18,509 33

EXPENDITURES.

Salaries of secretary, assistant librarians and janitor,	$2,232 75	
Cost of books, periodicals and binding	819 45	
" " publications and printing	1,379 26	
" " fuel,	181 50	
Paid for gas and water,	42 66	
" " repairs	151 79	
" " insurance,	30 00	
" " interest on note,	45 75	
" " our proportion of Salem Athenæum expenses,	226 57	
" " express, postage and sundries,	287 29	
" annuities (obligations of legacies)	710 00	$6,107 02
" note,		1,500 00
Investment of legacy from estate Mrs. Nancy D. Cole,		10,327 75
Interest added to manuscript fund,	51 82	
" " " North Bridge monument fund,	6 84	58 66
Balance of cash on hand,		515 90
		$18,509 33

May 16, 1892.

Respectfully submitted,
WILLIAM O. CHAPMAN, *Treasurer.*

Examined and approved,
(signed) GEO. D. PHIPPEN, *Auditor.*

INVESTMENT OF FUNDS

For income, ...	$71,655 51
" Essex Institute Building, ...	28,370 69
" Ship Rock and land, ...	100 00
Total investments,	$100,126 20

Salem, May 12, 1892.

Examined the above account with the securities and found them correct.

(signed) GEO. D. PHIPPEN, *Auditor*.

REPORT OF PUBLICATION COMMITTEE.

The sub-committee appointed to take charge of the publications of the Institute report that these publications are now substantially completed up to date. There was some delay in the publication of volume twenty-three of the Bulletin, owing to the necessity of reprinting a portion of the paper by Mr. J. Walter Fewkes upon the "Cœlenterata of New England," but this volume, which is for the year 1891, has now been issued. It contains, besides the annual report, the paper by Mr. Fewkes just mentioned, papers by Messrs. S. and H. Garman, also numbers three and four of the " Geological and Mineralogical Notes" by Mr. John H. Sears of the Peabody Academy of Science. These notes, containing the results of Mr. Sears's work on the rocks of Essex County are especially valuable. There are now in the hands of the committee, ready for the next volume — volume twenty-four — of the Bulletin, valuable papers furnished by Prof. E. S. Morse, Mr. Fewkes, Mr. Garman and others. Of the Historical Collections, volume twenty-seven for the year 1890 has been published during the past year and contains a paper on Gov. John A. Andrew by Hon. Eben F. Stone, a continuation of Mr. Sidney Perley's " Notes on Boxford Houses," " Reminiscences of Capt. James Barr" by Mr. J. B. Curwen, genealogical memoranda relating to the Allen, Sparhawk and Prince families and a " Rough Subject Index to the Publi-

cations of the Essex Institute" prepared by Mr. Gardiner M. Jones. Two numbers of volume twenty-eight, for the year 1891, are already in print and there is in the hands of the committee enough material to complete the volume. The committee was fortunate in securing for this volume from Mr. H. F. Waters, some of his "English Gleanings" consisting of extracts from marriage licenses granted by the Bishop of London 1598-1639. These were carefully annotated by Mr. Waters and are of great interest and value to genealogical students. They will be found in the parts already published.

There has been one special publication issued by the committee during the year, consisting of a series of articles on "Our Trees,"—that is, the trees of Salem and vicinity—written by Mr. John Robinson of the Peabody Academy of Science. By an arrangement entered into with the late Hon. Nathaniel A. Horton, in whose paper these articles originally appeared, and by advance subscriptions obtained, the cost of this to the Institute was rendered almost nominal, and the edition, which was limited to three hundred copies, is practically exhausted. The committee believes that it is within the province of the Institute and will prove useful in keeping alive an interest in local matters to issue such publications as this whenever suitable matter for them can be procured, whether it be of an historical character or upon some branch of natural history.

In publishing volume twenty-seven of the Historical Collections the committee tried the experiment of printing it in a single volume without issuing separate numbers or parts as has been the custom heretofore. This plan seems to the committee to be more satisfactory and it is recommended that in future the Historical Collections be thus published.

While it is not to be expected that there will be a pop-

ular demand for such publications as those of the Institute sufficient to make them financially profitable, there can be no question that they are extremely valuable in maintaining the reputation of the society and as a means of obtaining exchanges. The committee believes the question worthy of careful consideration, whether these publications cannot be made of much greater value to the Institute by suitable efforts to enlarge the field of exchanges. It unhesitatingly recommends that the publications be continued and that every encouragement possible be given to those who are trying to do good historical and genealogical work, especially that relating to this locality. The committee suggests that the council consider the advisability and practicability of raising a publication fund which will furnish an income sufficient to pay all expenses of publication so that the Institute may be insured against the possibility of any pecuniary inconvenience on account of the maintenance of this department. It is recommended that the copies of the society's publications now on hand should be arranged properly by volumes and a special opportunity extended to such libraries and societies as are subscribers to these publications to complete their sets so far as possible. A new catalogue and price list of the publications should be prepared, and the committee recommends that the price to members of the Institute be placed as near cost as practicable, while the price to those not members for papers which have become scarce should be increased.

William H. Gove,
T. F. Hunt,
Geo. M. Whipple.

LECTURES.

Monday, Jan. 4, 1892.—Wm. A. Mowry, Esq., of this city lectured on the subject of "United States Boundaries, and Boundary Commissions." Mr. Mowry first called attention to the importance of the study of the history of our own country, alluding to its rapid growth, great resources and wealth. The original United States, whose boundaries were fixed by the treaty with Great Britain at the close of the Revolutionary War, embraced a territory of 827,844 miles. Its bounds were the Atlantic Ocean on the east, the St. Lawrence River and the Great Lakes on the north, the Mississippi River on the west, Florida on the south. The first joint international commission for running a boundary line, was that between the United States and Spain, for making the line between this country and Florida. Andrew Ellicott was our Commissioner; this was in 1798-9. The lecturer described Mr. Ellicott's work. The Florida Treaty of 1819 and the Oregon Treaty of 1842, were both fully explained, as well as the Commission to settle the boundary between this country and Mexico in 1848, after the Mexican War and the Gadsden purchase of 1853 and Alaska in 1867.

The *original* territory was (in square miles)	827,844
The Louisiana purchase, . . .	877,686
" Florida "	65,168
" Annexation of Texas . . .	376,161
" Mexican Cession	545,783
" Gadsden purchase . . .	45,535
Oregon	288,345
Alaska	577,390
Total	3,605,912

Our country, the speaker said, included all degrees of

latitude, from within the torrid zone, to and beyond the arctic circle and extending from the Atlantic to the Pacific and has such vast resources, as to be practically independent of the rest of the world.

Monday, Jan. 18, 1892.—A. A. Post, Esq., of Boston, lectured on the new language called "Volapük." Mr. Post is the Massachusetts Director in the North American Volapük Association. The *Salem Gazette* says of the lecture: "The least that can be said is, that it presented an array of facts very remarkable and interesting to even those who may not fully accept all of the lecturer's deductions from those facts." This language was invented thirteen years ago by a Roman Catholic priest.

For four years it remained dormant; after that it began to attract attention. University professors in Vienna first recognized its merits and established a club for the propagation of the tongue. It was subsequently welcomed in Russia, Sweden, Norway, Holland, Belgium, Italy, Spain, China and Japan, and within two years from its start, it found friends in every civilized land, and first by the learned men of the various countries. Forty-seven journals have been established and maintained either wholly or in part in Volapük. In general literature it has a bibliography of many hundreds of volumes, history, science, poetry, etc. Its clubs number one thousand, and it is used by more than one thousand mercantile houses. Lecture courses in this language have been given abroad. Mr. Post emphasized the fact that the inventor of Volapük did not propose it to be anything more than an international language. It was not intended to supplant any or all natural languages. Its position is not revolutionary or reformative. It is designed only as a supplementary language to make international communication easier. If

the Volapük should come into general use throughout the civilized world, then there would be no necessity of learning a multitude of different languages as is now the case, but the scholar or whoever wished to communicate with other countries could learn Volapük.

Monday, Jan. 25, 1892.—Rev. G. T. Flanders, D.D., of Boston lectured on "Our Aryan Ancestors." The lecturer said that the Aryan race, came from northwestern Asia, and from them all the Europeans are descended. Their language (the Sanscrit) is the root of all European languages, including even the dead languages, Latin, etc. The Sanscrit, he said, is the only perfect language known. As a proof of the common origin of all European nations he cited the fact that they all assimilate, whereas the Chinese and other nations not springing from the Aryan race will not assimilate.

No modern family knows its genealogy with greater accuracy than we can trace ours back to our Aryan ancestors, the clew being chiefly philological. The conquest of India by the English, and the discovery of Sanscrit in 1784, opened the way.

He then gave a few specimens to show how affiliations of language prove a common origin of peoples.

In conclusion, Dr. Flanders told how the Aryan race has perfected society, morals, science, art and philosophy. It seems to be their mission to link all parts of the world together and establish upon the earth a common brotherhood and a common language. Slowly, but surely, all varieties of our race are coming to be of one speech. From unity to diversity and from diversity to final unity is the irresistible law.

Monday, Feb. 1, 1892.—Rev. Joseph Kimball of An-

dover lectured on "Arts: Present and Future" or a consideration of the present and prospective condition of the domestic arts. He spoke at some length of the various uses of paper in recent years, and of the numerous and increasing applications of glass to the purposes of economy and of ornament. He referred to the marvellous talent shown in the preparation of articles of food and the use of machinery in this way. References were also made to steam and electricity for motive power, and its possible developments in the future. The lecture was illustrated by humorous anecdotes and allusions.

Monday, Feb. 8, 1892.—Prof. Edward S. Morse of Salem lectured on Japanese Pottery. The lecturer said that the most civilized nations do not necessarily produce the most artistic pottery. In the rudest tribes we sometimes find traces of high artistic merit; but where the highest cultivation is combined with artistic taste, the effect cannot fail to be charming. The Japanese are superior in these qualifications and we find them excelling all other nations in their pottery. Their pottery of any decided merit dates back not more than four hundred years. On account of the limited communications in Japan we find the pottery of each of the provinces has a distinctive character. In other countries it is of one general type. The Japanese excel in porcelain also; but in this they do not show the same originality of design. Their pottery is to their porcelain as the etching is to the steel engraving. The Japanese potter has a heavy wheel on the ground which he causes to revolve rapidly, and as he is on his knees on a level with the wheel, has complete control over the clay before him, and is thus enabled to produce the most delicate pottery. In Japan the calling of a potter is considered a very honorable one, and hence attracts the most talented

of the people. Poets and philosophers have made pottery, and much of its refinement there is due to the company the potters kept. The making of pottery in Japan is more of an art than a business. It is for the most part conducted by families and a large part of it is made to order. Nine millions of dollars are spent every year for foreign pottery by our country, and this might just as well be made at home, if our potters could be educated up to it; and in this connection the lecturer spoke in praise of the Beverly Pottery. The lecturer said the Japanese displayed artistic taste even in the most common things.

Monday, Feb. 15, 1892.—Sidney Perley, Esq., of Salem lectured on "Prehistoric America." Mr. Perley divided American history into three periods, commencing with the latest. The first covered the years from the time when explorations and attempts at settlement were made by civilized people at about the beginning of the sixteenth century down to the present era. The second covered the time when the Indians flourished here. The third or prehistoric period related to races that preceded the Indians. He spoke of man's existence here before the drift period, when the moraines and many of our knolls were formed by the flood and glacier, burying human beings beneath the gravel deposits, together with their implements of various kinds and their pottery. He mentioned the ruins of Arizona, dwelt upon "mound builders" especially and gave a very interesting sketch of the discoveries in their region principally along the banks of the Mississippi river and its tributaries. The salt mines, mica mines and the ancient copper diggings were spoken of at some length. Mr. Perley thought that the Indians and the "mound builders" were probably modern, as compared with the races of man that once existed here. He also said that geologists

agree that North America is the oldest continent geologically and probably man existed here first, so that instead of races coming here from Asia, they probably went from here to Asia. This lecture was illustrated by large crayons, of plans, sketches of mounds and drawings of idols, copper implements, pottery, etc.

Monday, Feb. 22, 1892.—The lecture this evening, by Mr. J. Walter Fewkes of Boston, was on the "Study of an Aboriginal Ceremonial." The lecturer stated that among the Moki Indians of Arizona, a series of primitive religious rites are performed of which, at least one occurs, in every month. As each of these religious ceremonials occupied nine days, it could readily be seen how much time during each year was taken up by such observances. It is impossible, to understand the meaning of them, until more is known of the details of them all. The ceremony that attracted the most attention was the Snake Dance as it is called, which is celebrated biennially in two of the pueblos. This was not the most important of their ceremonials although, from its weird character, it was the most widely known. Mr. Fewkes then proceeded to describe very fully the performance of the Snake Dance, detailing all the events, and spoke of its meaning, which he considered was a ceremonial for rain. The lecture was illustrated by stereopticon views.

Monday, Feb. 29, 1892.—The two hundredth anniversary of the beginning of the witchcraft delusion in Salem, was observed by the society at Academy Hall. There was a very large and interested audience who listened for two hours, with the closest attention, to the different speakers.

Upon the stage were Professor E. S. Morse, Professor D. B. Hagar, Rev. Charles B. Rice of Danvers, Mayor

Robert S. Rantoul, W. S. Nevins, Professor Barrett Wendell of Harvard College, Abner C. Goodell, jr., Dr. A. P. Putnam of Concord, W. A. Mowry, superintendent of the schools of Salem, Ross Turner, Hon. Charles S. Osgood and Secretary Henry M. Brooks.

Mr. Nevins called the meeting to order and said that it was not desired by the committee or by the Essex Institute that anything should be said or done to bring discredit upon the Salem of 1892 by rehearsing the story of 1692, but it was only with the hope that the matter might be so presented as to divest the name of Salem from the possible stain thrown upon it by prevalent misconceptions of the character of the people and the proceedings of that era. If Salem did not do something in presenting the truth regarding that time, other historians would, and was it not much better that the narrative should be told by their own local historians who were familiar with the subject, than that the task should be assigned to strangers. Mr. Nevins read the warrant for the arrest of Sarah Good, Feb. 29, 1692, and then presented Mayor Rantoul as chairman of the meeting.

The Mayor, on taking the chair, said :—"History imposes on us to-night a delicate and difficult task. We are here to commemorate something we would willingly forget. The witchcraft horror, the terrible frenzy which overtook our ancestors two centuries ago,—is a chapter in our local annals which I for one would make haste to blot out forever if I had it in my power to do so. All that can be said in extenuation, all that can be said to the personal credit of the few who stood up bravely against the wretched business, to the honor of Judge Saltonstall, who retired from the court rather than give his judicial sanction to the hearing of the miserable charges, to the honor of goodman Woodbury whose horse stood ready saddled, night

after night in his barn, for the use of neighbors who might be accused and might escape with his aid to New Hampshire, to the honor of the venerable ex-governor Bradstreet, of whom Upham intimates that, had he remained governor another year, the frenzy would never have gained head, to the honor of his successor, Sir William Phips, who, when Lady Phips began to be accused, looked into the matter and cried a halt, all that can be charged off to the advantage of the few who, earlier or later in the proceedings discovered their dreadful error and in humiliation and sincerity repented of what they had done,—such as Judge Sewall, Ann Putnam, the Rev. John Hale—all these things and the added plea that others elsewhere held the same beliefs, that persons as guiltless suffered like enormities in other places, before and since, under the malignant influence of this awful creed, all this does not wipe out the appalling fact that right here in Salem at the hands of our own ancestors whom we honestly revere and hold up as better than their time in many ways, twenty innocent persons, mostly women, were by their own neighbors done to death, at intervals of weeks, with slow deliberation and the forms of law, upon flimsy and unsubstantial statements, the victims denied those rites and consolations of religion which society affords to the most hardened of offenders, excommunicated from the church they loved, outlawed of heaven and earth, even the poor solace of Christian burial denied their ashes.

A phenomenon like this may well startle us from our complacency and make us pause.

It is for others to account for and explain it. The task is not for me. Scholars learned in the research of the period in question, familiar with its social atmosphere, and initiated by virtue of long investigation into the mysteries of its deluded thought, are here to address you to-night,

and it becomes me to resign the hour to them. They will offer you explanations and reflections for which their position and studies will command respect. We all have our theories. We have in the Uphams, father and son, able guides to a just conclusion. The interchange of views, on a centennial like this, cannot but be welcome and inspiring to all of us.

I find, then, an excuse for this commemoration, if excuse it need, in the belief that the wretched slaughter of women, in 1692, whether we will it or not, will be remembered. Had they perished by conflagration, by shipwreck, or by flood, by any agency where no human motive intervened, their fate had been sad indeed, but time would slowly wipe out the living memory. Had they died by Indian massacre even, or by famine or by siege, the memory of it would linger long, but not forever. Not the number of the victims, not so much the character of the victims, but the nature and animus of the violence under which they fell, determines, I think, the final judgment of mankind. Smithfield and the Inquisition will not be forgotten; the bloody upheaval in France a century ago will not be forgotten; the groundless strangulation in Salem two hundred years ago will not be forgotten.

I ask your attention, therefore, to what is about to be said, in order that we may help to record and hand down the actual fact and not expose our ancestors to the distorted misconceptions of writers who may not feel the solemn obligation resting upon us to see to it that the censure is apportioned to the fault. I shall rejoice if persons who have supposed us anxious to keep alive these memories for our own aggrandizement shall be persuaded by the solemnity of this occasion, that such is not the fact, and that while we cannot shape our history, we accept it in all seriousness as it is, and have no disposition to treat in a light

or trifling spirit the saddest of all episodes in the noble annals of a noble race."

Prof. Barrett Wendell of Harvard College was first introduced by Mr. Rantoul.

Mr. Wendell's paper,[1] while carefully disclaiming the scientific and historical learning that should give his views authority, suggested that his observation of modern occultism revealed so many points of likeness to matters testified to in the trials of the Salem witches as to lead him to believe that the witchcraft was really something resembling an epidemic of hypnotism. He further expressed belief that whoever practised hypnotism in the seventeenth century could hardly have failed to believe himself in league with the devil. From this would follow a strong probability that some of the witches may have been morally guilty.

Professor Wendell spoke of his own psychic researches. He had studied the work of the materializing mediums, which he had no doubt were indubitably frauds, and had observed the trance mediums and tried automatic writing. He dwelt especially upon the debasing and degenerating effect that all of these had upon the operator. He cited one case of an undoubtedly honest young woman who was capable of going into a trance, and who in that condition undoubtedly did things of pure charlatanry and subtle untruth. He had himself found the automatic writing to leave him in such a state of nervous irritability that at times he was almost ready to admit that he himself had partially helped the pencil along, and yet when charged with it was at once eager and ready to deny it.

He had taken Mr. Upham's admirable books and had studied the life of Cotton Mather and found him not at

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[1] See Hist. Coll. Essex Inst., Vol. XXIX, p. 45.

all the deliberate villain he had been led to believe him. The more he read of him the more he was struck with the familiarity of his type. The controlling spirit of this grotesque tragedy, its atmosphere, had something which he had known in his own experience. It was a horribly tragic fraud then and is a strangely grotesque one to-day. He cited the case of Mary Warren in her fits as one of undoubted hypnotism. These girls had apparently carried hypnotism to excess, and partook of just such consequent moral debasement as we see to-day, about the purlieus where occultism in its lowest forms is practised. The bulk of the evidence was spectral. It was this absurd evidence which hung the witches; it was its rejection which stopped the witchcraft trials.

The case of Rebekah Nurse was another instance of excessive hypnotism. Rebekah Nurse bent her neck and immediately all of the afflicted had their necks similarly twisted. This was nothing against Goody Nurse, but when Abigail Williams cried out to set the neck of the accused straight or Elizabeth Hubbard's neck would break off, it simply showed that Betty Hubbard's vision was so greatly diseased by hypnotism that she was involuntarily under its subjection. From this, the speaker asked, with their awful view of Calvinism, was it not probable that these people ascribed this condition to God or Satan?

Rev. Charles B. Rice of Danvers was introduced as the successor of Samuel Parris. Mr. Rice made a witty speech. He said he had come down more especially to see that the sin of Salem in this witchcraft business was not all shoved off upon Danvers. The fact was that the delusion was short and sharp in Danvers, and then the people were prompt to confess their error. In Salem the confession was rather slow and canting.

He had said the afflicted girls were possessed of a hyp-

notic hysteria, mixed with wickedness, and he stood by that definition. The preceding speaker had stated their case pretty fairly, but when he expressed the view that the accused had some of this power and exerted it he should be slow to believe that. He believed each individual was guiltless.

He did not think much of Cotton Mather who was brought up precociously and flattered too much when a boy, and thought a great deal too much of as a minister. He thought we should be slow to admit that our fathers were worse than their generation in the world.

Mr. Rantoul then read the following letter from William P. Upham:

Newtonville, Mass., February, '92.

W. S. Nevins, Esq.

My dear Sir :—

Your kind invitation to attend the meeting of the Essex Institute, February 29th, is received. I regret very much that I shall be unable to be present.

One of the many signs of the amelioration in the general tone of public sentiment which the more advanced thought of our day has produced is the tender regard paid to the memory of the unfortunate victims of the sad delusion of 1692.

I am glad the Essex Institute proposes to give expression to this feeling.

Very truly yours,
Wm. P. Upham.

Dr. William A. Mowry was next introduced and spoke substantially as follows :—

"Talleyrand is credited with saying that words were invented to conceal one's thoughts. It would seem, sometimes, that history was invented to keep out of sight the facts which have taken place in the past, and to substitute therefor a series of tales, legends and slanders concerning those who have lived before our time, which sometimes are scarcely even founded on fact.

In the recent ecumenical conference in Washington, Bishop Fowler is reported to have said he thanked God that "Methodism never whipped a Quaker, nor burnt a witch, nor banished a Baptist to Rhode Island."

This is a very striking statement. It has a ring to it. It sounds well. Probably, when it was written, it "brought down the house." Let us examine it a little. I do not propose to raise any question as to its truth. Surely, also, the triple statement is creditable to that excellent denomination of Christians. Several things, however, may be noticed about it:—

1. Methodism had no existence till well along in the eighteenth century, say about 1730. The banishment of Roger Williams, the persecution of the Quakers and the New England witchcraft, all occurred in the seventeenth century. Methodism, therefore, could not very well have anything to do with these occurrences.

2. New England never burnt a witch.

3. Roger Williams, when ordered to leave the Bay Colony, was not a Baptist, had no intention of becoming one, and did not become one till at least three years subsequent to his founding his settlement in Rhode Island.

The well-known S. S. Cox, in a speech defending the South, once spoke of witches having been burnt in Massachusetts. Senator Vance, of North Carolina, only a year or two ago in a speech alluded to Massachusetts as having burnt witches at the stake.

Now, so far as I know, the only witches ever burned at the stake in this country were burned at the South, and that long after the Massachusetts Bay Colony had set the example to the world of opening the jail doors, and setting free all persons who had been charged with witchcraft.

The law of King James I, "against conjuration, witch-

craft and dealing with evil and wicked spirits," was declared to be in full force in South Carolina, about the year 1710, seventeen years after the famous jail opening in Salem.

The speaker defended Salem and the Massachusetts Bay Colony as being at the time of the witchcraft delusion, ahead of their time, and that their action in discontinuing all prosecutions against supposed witches in 1693, opened the eyes of the world, and that from that day witchcraft was doomed and the delusion rapidly passed away. This happy result is directly traceable to the action of the Bay colony in 1693 at Salem.

The closing speaker was Hon. Abner C. Goodell, jr., who rehearsed what he had said at Danvers briefly. He said, however, that he did not agree with Mr. Rice regarding the ministers. He thought if a concensus of their views had governed, there would not have been any executions, for they did not believe a spectre could act through an innocent person. He defended the judges from too harsh a criticism as they only followed English authorities who regarded witchcraft as one of the worst of crimes. He alluded to a most valuable work on witchcraft, Rev. Samuel Willard's, which contained the opinions of Philip English and John Alden after their return from banishment.

Monday, March 7, 1892.—Rev. A. P. Putnam, D.D., of Concord, Mass., lectured. His subject was "The Wenham Lake Ice Company." Dr. Putnam first spoke of the great value of ice for its various purposes and alluded to the manner in which the Greeks and Romans preserved their snow for summer consumption; and then spoke briefly of the old New England family ice-houses half under ground or set into the declivity of a hill. He also gave a history of the early export ice trade of New England which was begun about 1805, by Frederick Tudor of

Boston, and continued by him and others shipping ice to the East and West Indies down to 1860 or later, The Wenham Lake Ice Company was first formed in Danvers largely through the influence of Mr. Joshua Sylvester in 1847. A partnership was formed by Henry T. and Joseph W. Ropes, natives of Salem, and Wm. L. Weston for the purpose of gathering and exporting ice to England; a similar business had been started a few years before by Charles B. Lander and others of Salem, who had offices in London and Liverpool and ice-houses on Wenham Lake. Dr. Putnam spoke at some length of the character and enterprise of the Messrs. Ropes and other Danvers and Salem people, and in this connection paid a tribute to the worth of Messrs. Reuben W. and Ripley Ropes, natives of Salem whom he had known in Brooklyn, N. Y. The ice from Wenham Lake came to be known all over Great Britain, for its purity, so that at length some English ice dealers purchased a lake in Norway and named it Wenham Lake, and it is said, that at this day signs can be seen in British ports of "Wenham Lake Ice," which is known to have been imported from Norway.

Monday, March 14, 1892.—Sylvester Baxter, Esq., of Boston, lectured on "Municipal Democracy." The speaker said that our large cities were the worst governed of any in the world. It was caused by a neglect of public affairs by the better element of citizenship, leaving the matter of municipal government to the self-seeking and unscrupulous, and, as a result, we have official incapacity, sectionalism, wastefulness, high tax rate with low returns, etc. This popular neglect and indifference are the main factor in the problem. The majority prefer good government to bad, as has been demonstrated in times of popular uprisings against glaring evil. The burden of taxation is

distributed among the common people. The burden of the waste of funds of a city does not fall mainly upon capitalists, but on the daily wage earners, in the shape of higher prices for shelter, food, etc.

Under certain conditions a high tax rate may be the truest economy, as when it is accompanied with wise outlays. The lecturer spoke of foreign models, notably among the best was Berlin, where it is considered an honor to be a member of the city government.

Monday, March 21, 1892.—Col. Henry Stone of South Boston, lectured on the "Life and Character of General Sherman." The lecturer said, no man of recent times has received so much unmeasured praise as General Sherman. He then proceeded to give in detail an interesting sketch of the General's eventful life, whose most marked characteristics he said were his mental and physical activity. He was a tremendous worker, and his mind was always alert, vigorous, inquisitive and energetic. Wherever he went he was a leader. His writings are full of pungent sayings, and he was master of the pen, if not always of the sword. He was overflowing with loyalty and devotion to his country, and some of his letters, especially that to the Governor of Louisiana, resigning his place there, deserve to be written in letters of gold.

Monday, March 28, 1892.—Rev. E. O. Dyer of South Braintree, lectured on "Coligny and the Huguenots." He gave a sketch of Coligny's life, of his birth, training, military advancement, imprisonment and acceptance of the "reformed faith," and also of his attempt to plant a colony of French Protestants in Florida; his successes, the massacre of St. Bartholomew, his murder, and the estimate of his worth were all alluded to, the speaker

saying that he was one of the finest characters in history. Mr. Dyer gave a sketch of the Huguenot movement from the death of Coligny down to the French Revolution. He also gave a very graphic account of the Huguenots from the time of the Edict of Nantes in 1598, to its revocation in 1685, and spoke of the emigration of the Huguenots to America, South Carolina, New York and Massachusetts.

Monday, April 4, 1892.—Dr. J. E. Wolff of Boston, lectured on the "History of Rocks learned by the Microscope." This was accompanied by graphic illustrations on the screen. The nature of rocks was first dwelt upon as forming part of the crust of the earth, and the manner in which they came to occupy the positions, where we now find them, explained—Thus rocks may have come in a melted state from deep down in the interior of the earth, and either have solidified at a depth, or pushed their way to the surface and flowed as the lavas of the present day; these are the volcanic or eruptive rocks,—or, the waves, washing along beaches and rivers carrying down sediment, may have piled up masses of sand and mud, which in the course of ages were buried with further masses hardened and consolidated, and thus our present sandstones and slates formed,—or in the deep water of the sea small organisms by their shells or in other ways may have formed the great beds of limestones which we use for our lime and building stone. After the rocks in these different ways have taken their places in the crust, they have shared in the great movements of the solid crust of the globe. The slow processes of decay have more or less affected the minerals of the rocks. Various illustrations of the processes of preparing thin slices of rock for the microscope were shown and explained. The lecturer spoke in conclusion

of the fine collections made by Mr. Sears at the Peabody Academy of Science.

Monday, April 11, 1892.—Dr. Philip C. Knapp of Boston, lectured on "Hypnotism." The speaker after stating that hypnotism was by no means a new discovery, proceeded to give some historical account of it from the time it was first heard of in the sixteenth century down to the present time. He then gave a detailed statement of what hypnotism is;—an induced artificial sleep, with an increase of reflex excitability and of suggestibility. It has nothing to do with magnetism or personal influences. Any one can hypnotize, but only a limited number can be hypnotized. A prominent characteristic of people in this state is that they respond to every idea suggested to them. If told that they are paralyzed or drunk, they act in accordance with the idea suggested. Instances were given of very curious results of suggestions. It is not however due entirely to suggestions, for animals can be hypnotized. It is closely allied to hysteria and is regarded as an acute mental disease. Its use might lead to insanity. Persons under its influence might be led to do improper acts, sign papers, impart information, or commit crimes.

Monday, April 25, 1892.—Hon. Alden P. White read in the lecture course, in a most interesting manner, selections from the poet Tennyson, which best illustrated the story of "The Passing of King Arthur" as told in the old legends of the Round Table. A short informal talk on the subject preceded the reading.

Monday, May 2, 1892.—Ezra D. Hines, Esq., of Danvers lectured, his subject being "A Day at Lexington." In a most entertaining manner, he gave a full account of a visit of the Danvers Historical Society to Lexington in

September, 1891. He spoke of the place as a Mecca which all Americans should visit at least once in their lives. Lexington was formerly a part of Cambridge and was made a town in 1713. Mr. Hines continued with an exceedingly interesting historical sketch of the scenes in Lexington on the day of the battle, April 19, 1775.

Necrology of Members.

Augustus S. Browne, son of Sewell and Abigail (Kimball) Browne, was born in Seabrook, N. H., Mar. 2, 1834; elected a member of the Essex Institute, Jan. 16, 1888, and died in Salem, Jan. 25, 1892.

Benjamin W. Crowninshield, son of Francis B. and Sarah G. (Putnam) Crowninshield, was born in Boston, Mar. 12, 1837; elected a member of the Essex Institute, Feb. 6, 1888, and died in Rome, Italy, Jan. 16, 1892.

Rufus B. Gifford, son of Thomas and Sarah P. (Ravel) Gifford, was born in Salem, Mar. 7, 1827; elected a member of the Essex Institute, Oct. 20, 1873, and died in Salem, Apr. 3, 1892.

Nathaniel A. Horton, son of Nathaniel and Martha (Very) Horton, was born in Salem, Apr. 16, 1830; elected a member of the Essex Institute, June 11, 1852, and died in Salem, Dec. 14, 1891.

Mrs. Catherine K. Ireson, widow of Samuel J. Ireson and daughter of James and Catherine (Russell) Kimball, was born in Salem, Apr. 19, 1811; elected a member of the Essex Institute, Dec. 6, 1886, and died in Salem, Aug. 19, 1891.

George R. Lord, son of Nathaniel and Eunice (Kimball) Lord, was born in Ipswich, Dec. 16, 1817; elected a member of the Essex Institute, June 4, 1874, and died in Salem, Dec. 25, 1891.

George B. Loring, son of Bailey and Sally (Osgood) Loring, was born in North Andover, Nov. 6, 1817; elected a member of the Essex Institute, Jan. 10, 1855, and died in Salem, Sept. 13, 1891.

Mrs. Martha A. Nichols, widow of David Nichols and daughter of Robert and Lydia (Kilburn) Proctor, was born in Salem, Aug. 2, 1810; elected a member of the Essex Institute Nov. 21, 1876, and died in Salem, Feb. 2, 1892.

George Peabody, son of Joseph and Elizabeth (Smith) Peabody, was born in Salem, Jan. 11, 1804; elected a member of the Essex Historical Society, Sept. 6, 1828, and of the Essex County Natural History Society in 1834, and died in Salem, Jan. 3, 1892.

George Roundy, son of Nehemiah and Margaret (Pickett) Roundy, was born in Beverly, Feb. 20, 1824; elected a member of the Essex Institute July 3, 1865, and died in Beverly, Nov. 2, 1891.

John H. Silsbee, son of William and Mary (Hodges) Silsbee, was born in Salem, June 17, 1814; elected a member of the Essex Historical Society, Sept. 8, 1846, and of the Essex County Natural History Society, Mar. 17, 1843, and died in North Conway, N. H., Sept. 19, 1891.

Frank Stone, son of John U. and Eliza J. (Flint) Stone, was born in Salem, Jan. 14, 1854; elected a member of

the Essex Institute, Jan. 17, 1887; died in Salem, Aug. 26, 1891.

Cyrus M. Tracy, son of Cyrus and Hannah M. (Snow) Tracy, was born in Norwich, Ct., May 6, 1824; elected a member of the Essex Institute, Oct. 6, 1858, and died in Lynn, Sept. 28, 1891.

James D. Waters, son of William D. and Abigail (Devereux) Waters, was born in Salem, Oct. 28, 1832; elected a member of the Essex Institute, Feb. 3, 1853, and died in Salem, Feb. 19, 1892.

John Webster, son of Elijah and Sally (Dole) Webster, was born in Salem, Oct. 10, 1804; elected a member of the Essex Institute, Sept. 19, 1855, and died in Salem, Dec. 19, 1891.

Stephen G. Wheatland, son of Richard G. and Mary B. (Richardson) Wheatland, was born in Newton, Aug. 11, 1824; elected a member of the Essex County Natural History Society, Oct. 18, 1844, and died in New York, Mar. 2, 1892.

Mrs. Martha A. Willson, wife of Rev. E. B. Willson and daughter of Stephen and Patty (Wheeler) Buttrick, was born in Framingham, July 20, 1817; elected a member of the Essex Institute, Nov. 7, 1887, and died in Salem, Nov. 7, 1891.

Charles Woodbury, son of Israel and Susan (Luscomb) Woodbury, was born in Salem, N. H., Jan. 28, 1831; elected a member of the Essex Institute, Nov. 18, 1889, and died in Salem, Sept. 16, 1891.

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Northey, William, - - - - - Newspapers,	82	3
Norwich (Ct.) Academy, - - - - - -		1
Nourse, Dorcas C., - - Newspapers and Circulars,		
Nunns, F. H., Baltimore, Md., - - - - -	1	
Nurnberg, Naturhistorische Gesellschaft, - - -		1
Oliver, Mrs. Grace A., - - - - - - -	4	13
Osgood, Charles S., - - - - - - - -	132	13
Ottawa, Geological and Natural History Survey of Canada, - - - - - - - - - - -	1	
Palermo, Reale Accademia di Scienze, Lettere e Belli Arti, - - - - - - - - - -		1

Palfray, Charles W., - - - - -	Newspapers,		85
Paris, Société Nationale d'Acclimatation, - - -			23
Paris, Société d'Anthropologie, - - - - .			4
Parker, Mrs. William P., - - - - - -		28	
Parker, William Thornton, Beverly, - - - -			1
Peabody, George L., Philadelphia, Pa.,	Newspapers,		
Peabody Institute, Peabody, - - - - - -			1
Peet, Rev. S. D., Avon, Ill., - - - - - -			7
Perkins, George A., - - - - - - - -		4	68
Perley, M. V. B., Ipswich, - - - - - -		1	
Perley, Sidney, - - - - - - - - - -		1	
Perry, Amos, Providence, R. I., - - - - - -			1
Perry, Rev. William S., Davenport, Ia., - - -			1
Philadelphia, Pa., Academy of Natural Sciences, - -		1	4
Philadelphia, Pa., American Philosophical Society, -			4
Philadelphia, Historical Society of Pennsylvania, -			4
Philadelphia, Pa., Library Company, - - - -			2
Philadelphia, Pennsylvania Academy of Fine Arts, .			4
Philadelphia, Pa., Zoölogical Society, - - - -			1
Phillips, Stephen H., - - - - -	Newspapers,	52	114
Pool, Wellington, Wenham, - - - - - -			2
Poole, William F., Chicago, Ill., - - - - - -			1
Porter, Rev. E. G., Lexington, - - - - -			2
Portland, Maine Historical Society, - - - .			4
Providence, R. I., Brown University, - - - -			1
Providence, R. I., Narragansett Historical Publishing Company, - - - - - - - - - -			2
Providence (R. I.) Public Library, - - - -			1
Providence (R. I.) Record Commissioners, - - -		1	
Providence, Rhode Island Historical Society, - -		1	2
Putnam, Eben, - - - - - - - - - -		2	10
Quebec Literary and Historical Society, - - -			1
Queensland Branch of Royal Geographical Society of Australasia, - - - - - - - -			1
Quimby, E. H., Malden, . - - -	Newspapers,		1
Ramsay, Rev. William H., Middleboro', - - -			4
Rantoul, Robert S., - - - - - - - -		1	19
Rayner, Robert, - - - - - -	Newspapers,		
Read, Warren A., Boston, - - - - - -			1
Riga, Naturforscher Verein, - - - - - -			1
Rio de Janeiro, Museo Nacional, - - - - -			1
Roberts, Martha L., - - - - -	Newspapers,		8
Robinson, John, - - - - - -	Newspapers,	109	114

Robinson, Lucia P.,		1
Rochester (N. Y.) Academy of Sciences,		1
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St. Louis, Missouri Botanical Gardens,	1	
St. Louis (Mo.) Public Library,		1
St. Paul, Minnesota Historical Society,	1	1
St. Pétersbourg, Académie Impériale des Sciences,		11
Salem, City of,	1	1
Salem Fraternity, - - - - - Newspapers,		
Salem, Peabody Academy of Science, - Newspapers,	1	596
Salem Press Publishing and Printing Company,	2	5
Salem Public Library,		28
Saltonstall, Leverett, Boston,	1	
Sampson, Murdock & Co., Boston,	2	
San Diego (Cal.) Society of Natural History,		6
San Francisco, California Academy of Sciences,		1
San Francisco, Cal., Mercantile Library Association,		1
'S Gravenhage, Nederlandsche Entomologische Vereeniging,		2
Shaw, Mary L., - - - - - - Newspapers,		13
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Silver, William, Trustee,	1	
Smith, A. M., Minneapolis, Minn.,		1
Smith, Cassius C., Denver, Col.,		1
Smith, George Plumer, Philadelphia, Pa., - - - - - - - - - - - - Newspapers,		
Smith, William, Morley, New Leeds, Eng., Newspapers,		
South Boston, Church Home for Orphan and Destitute Children,		1
South Boston, Perkins Institution and Massachusetts School for the Blind,	1	
Spalding, J. A., for Hartford Insurance Companies,	1	
Springfield City Library Association,		1
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Springfield, Mo., Drury College,		1
Stavanger Museum,		1
Stebbins, Solomon B., Boston,	1	

Stewart, Alexander A.,			1
Stickney, W. J.,	Newspapers,		
Stockholm, Entomologische Föreningen,			3
Stone, Arthur R.,	Newspapers,	12	119
Stone, George F., Chicago, Ill.,		1	
Stone, Hannah,		1	
Stone, Robert,	Newspapers,		
Stone, William S.,	Circulars,		34
Sydney, Linnean Society of New South Wales,			1
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Tacoma, Washington State Historical Society,			1
Taunton, Old Colony Historical Society,			1
Taunton, Somersetshire Archæological and Natural History Society,		1	
Topeka, Kansas Historical Society,	Newspapers,		
Toronto, Canadian Institute,			1
Trask, William B.,			1
Trenton, N. J., Microscopical Publishing Company,			1
Trenton, New Jersey Natural History Society,			1
Tromso Museum,			2
Turner, Mary E., Detroit, Mich.,	Newspaper,		
Turner, Ross,		2	1
U. S. Board on Geographic Names,			1
U. S. Bureau of Education,			5
U. S. Bureau of Ethnology,		5	1
U. S. Bureau of Navigation,		1	
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U. S. Civil Service Commission,		3	1
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Upham, William P., Newtonville,		30	405
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Waltham, Massachusetts School for the Feeble-Minded			1
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Washington, Anthropological Society,			4
Washington, Smithsonian Institution,			4
Waters, David P.,		31	49
Waters, Henry F.,	Newspapers,	34	199
Waters, Joseph G., Estate of,		7	26
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Waterville, Me., Colby University,			2
Watson, Miss C. A., No. Andover,		3	14
Watson, S. M., Portland, Me.,			1
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Welch, William L.,	Newspapers and Maps,	11	79
Wheatland, Henry,		426	5
Whipple, George M.,	Newspapers,	1	4
Whipple, Prescott,	Newspapers,		37
Wien, K. K. Zoologisch-Botanische Gesellschaft,			4
Wiesbaden, Nassauischer Verein für Naturkunde,			1
Willson, Rev. E. B.,	Newspapers and Circulars,	11	234
Winnipeg, Can., Historical and Scientific Society of Manitoba,			6
Winsor, Justin, Cambridge,			35
Woods, Mrs. Kate Tannatt,			12
Worcester, American Antiquarian Society,			2
Worcester, Society of Antiquity,			3
Wright, Frank V., Hamilton,	Newspapers and Circulars,		79
Wright, W. H. K., Plymouth, Eng.,			7
Wurzburg, Physikalisch-Medicinische Gesellschaft,			11
Youmans, W. J., New York, N. Y.,			11
Zurich, Naturforschende Gesellschaft,			1

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American Journal of Education.
American Journal of Science.
American Naturalist.
Beverly Citizen.
Cape Ann Advertiser.
Chicago Journal of Commerce.
Danvers Mirror.
Georgetown Advocate.
Groton Landmark.
Home Market Bulletin.
Iowa Churchman.
Ipswich Chronicle.
Lawrence American.
Learner and Teacher.
Le Naturaliste Canadien.
Lyceum Herald.
Musical Herald.
Musical Record.
Nation.
Naturalists' Leisure Hour and Monthly Bulletin.
Nature.
New England Magazine.
Open Court.
Peabody Press.
Peabody Reporter.
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